The Chemical Age

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Control of Chemical Processes

IN most modern chemical works, automatic regulators are beginning to be considered an essential part of the plant, though not yet applied to all processes. There exist a number of older works in which little has yet been done in this direction, and in many of the more up-to-date installations there remains much that might be done to improve the working of the process. The conference on automatic regulators held by the Chemical Engineering Group on October 15 and 16, has served a useful purpose if it has focussed attention on this important phase of chemical engineering. It seems absurd to devote so much time to the design of plant, and to leave the assembled installation without those essential aids to efficient working that can alone enable the best to be got out of the improved design. It is not always recognised that a few hours' inefficient operation may neutralise all the advantages otherwise accruing over a period of months from an improved design for which possibly a considerable extra sum may have been paid. Nor must measuring instruments be confused with regulators; neither must they be neglected. It is necessary for gauges, thermometers, meters and the like to be installed throughout the plant, but although essential as a guide to the operator, they do not of themselves *ensure* efficiency, but the interpretation of the facts they tell is dependent upon the operator, whose reaction, at the best, will have a considerable, and sometimes a very considerable, time lag. Instruments and regulators should now cease to be regarded as secondary equipment.

Much chemical plant is controlled by men specially trained for the work, who rely primarily upon experience. Many of the older generation of chemical engineers could relate tales of plant that seemed to respond almost miraculously to the handling of a particular man, who although unlettered and probably profoundly ignorant chemically, yet seemed to possess a "touch" that performed wonders. To this day temperatures are frequently estimated by eye and controlled by hand; the accuracy of the skilled working is surprising, but even the best men may nod, and if the skilled man is away for any cause he may for a time be irreplaceable. Usually, far more than a few weeks' training is necessary to fit a man to take charge of a chemical plant. Dr. W. J. Clark described the practice at Billingham, where originally control was effected manually. The plant is now controlled by the indication of instruments and it is stated that the cost of running the instruments is about one-fifth of the cost of process labour. That is a striking statement and Dr. Clark adds: "I do not think there is a doubt in anyone's mind about the economic necessity for these instruments. The continuous and steady running of plant depends on them. It is only from complete records (from instruments) that efficiencies can be continually checked—and decisions made as to which portions of the plant will best repay careful attention." He goes on to record a yet later development at the works of Imperial Chemical Industries: "We are now entering a new era in the control of plant by the introduction of automatic controls. Up to now automatic controls have been introduced in isolated points . . . but complete automatic control has only been introduced in the power gas plant, water gas plant and boilers." (These are automatically controlled in many industries.) "There is no reason why practically every chemical plant should not be controlled automatically." The advantages gained are from steadier control and saving of labour.

The literature of automatic control is large and increasing and it is becoming really difficult for a chemical plant manager to assess the value of any particular system of control from a study of such literature. Whether this conference will render the selection any easier we do not pretend to say; probably automatic control is fast becoming a specialist's job in-so-far as concerns its installation and upkeep. Designers must remember that if instruments—control or measuring—have to withstand maltreatment their price will be correspondingly greater. It is often possible in the original design to guard the instruments against corrosion, dust, dripping oil and water, steam, vibration and every extreme of weather. Temperature, humidity and pressure are the three functions in chemical industry in which automatic control is most common and the manufacturing plant should be arranged in accordance with the control selected before installation. It is frequently necessary to measure the flow of gases for which purpose proper piping and ducts should be arranged. Furnace, autoclaves and retorts must be designed with suitable provision for thermocouples or thermometer bulbs, due care being taken of such factors as radiation, flow past the measuring instrument and conduction losses. Messrs. L. B. Lambert and H. R. Walton give a lead to designers when they state that "there are many processes in which present-day standards of precision, uniformity and speed of production cannot be secured without reliable automatic controls, and yet the design of the primary or essential plant in which the process has been carried out has remained practically unchanged except in regard to size and capacity." It is to be hoped that this conference will have brought this aspect of the subject prominently before chemical engineers so that greater advantage may be taken of the new instruments and methods of control.

Notes and Comments

Increasing Chemical Imports

THE overseas trade returns published last week presented a somewhat less favourable position in regard to the chemical industry than that which prompted Mr. E. Wallace to remark at the annual meeting of the Association of British Chemical Manufacturers that the state of affairs was one which members ought to examine with great care and take such steps as they could to counteract it. Despite the operation of import duties imports of chemical products for the first nine months of this year showed an increase of £949,510 over the same period last year, and an increase of £856,233 over the first nine months of 1934. The bulk of the imports were again in respect of products for which there is adequate production in this country. Exports, on the other hand, decreased by £91,050 compared with 1935 and were only £159,973 higher than in the first nine months of 1934. It is evident that not all the anticipated benefits from the Ottawa agreements have accrued, for reasons which were not expected when the agreements were made. An important point to be borne in mind when they come up for revision is the protection of the United Kingdom maker against Empire competition, especially when the competitive industry is protected in its own market. Chemical manufacturers are hopeful that the Government will take the necessary powers to deal with such cases.

The Chemical Dinner

FOR some years past the annual Chemical Dinner has been held within a few days of Christmas, but since the Institution of Chemical Engineers has suspended its annual reception it has been found possible this year to arrange the Chemical Dinner for the third Thursday in November, a date which is certainly more convenient for the majority. Apart from the change of date the dinner will be on the usual attractive lines, the arrangements again being in the hands of Mr. F. A. Greene, to whom applications for tickets should be sent without delay. The dinner is unique in that it is not organised by any individual society but has become established as an annual opportunity for members, students and friends of some fourteen chemical organisations to gather, not to listen to long and tiresome speeches, but for real social intercourse. The venue is again the Wharncliffe Rooms at the Great Central Hotel, Marylebone, and the chairman this year will be Professor A. G. Green. The chief guest will be Sir Gilbert T. Morgan. There will be only two speeches, leaving as much time as possible for dancing.

Planning a New Factory

SOME 510 new factories were opened in Great Britain in 1935, 192 factories were extended, and 486 existing factories were closed. The Board of Trade's survey of industrial development officially described 13 of the new factories as chemical works, and showed that seven chemical works were extended and seven were closed, but it is more than probable that a great number of other factories dealt with in the survey were allied to chemical production. In any event the prospects are that with the continued improvement in trade the rate of development in the future will be no less rapid than in the past. It is opportune, therefore, to consider some of the details that have to be examined before a new factory can be built and equipped. In other pages we print the first of a series of articles in which Mr. J. H. West, who has had considerable experience in the work involved and its organisation, sets out the most important aspects of the problem. It would be presumptuous to suggest that all the details discussed in the article are entirely novel, but it would be equally futile to suggest that the last word has already been said in regard to the layout of the perfect factory. A disconcerting feature of the survey of industrial development to which we have referred was the large number of works closed down after only a year's operatons. We are compelled to wonder how many of these works would have continued in successful operation if they had been more carefully conceived and sensibly planned. It is in the hope of assisting the smaller chemical manufacturer who intends to develop a new factory to avoid some of the more obvious pitfalls that we are publishing this series of articles. If, in the course of the series, there are any points upon which readers desire additional enlightenment, we shall be pleased to do our best to supply the information required.

Transport of Chemicals

CO-ORDINATION of transport, or division of the functions of public carriers, is occupying the attention of the traffic committee of the Association of British Chemical Manufacturers, the membership of which has been increased this year in consequence of the growing importance of the problems encountered. The committee, whilst conscious of the desirability for the maintenance of fair and equitable competitive services, has expressed its willingness to agree, subject to the concurrence of other transport organisations, to an impartial body being constituted and authorised after full inquiry to remedy any waste through unnecessary overlapping of services; with the railway companies being enabled to operate on a sound financial basis, free of subsidies and other outside financial assistance; and with regulated tariffs operating in connection with all forms of public transport. It holds that no restriction should be imposed on the ancillary road user unless essential to safeguard the interests of industry, and in no case where service adequate to meet trade requirements can be obtained only by the use of traders' own vehicles. Apart from broad questions of co-ordination, much useful work has been done by the committee regarding the transport of chemicals by sea, road and rail, having regard to the requirements of the Poisons Rules, Home Office regulations, hauliers' licences, agreed charges, general repair of wagons, rebates, etc. Many points relating to the construction and maintenance of privately-owned railway wagons and the provision of stock suitable for conveyance on fast trains have been dealt with during the year.

It is estimated that 25,000 long tons of ammonium sulphate are produced annually in Scotland in the oil shale industry. There is a yield of approximately 40 lb. of sulphate from each ton of shale treated.

Automatic Regulators

Some Papers Presented at the Chemical Engineering Group Conference

CALCULATIONS underlying automatic regulation are generally based on differential equations relating movements of the control equipment with the temperature changes within the plant, said Dr. A. Ivanoff, Ph.D.(Eng.), M.Sc.(Eng.), of George Kent, Ltd., in a paper on "The Influence of the Characteristics of a Plant on the Performance of an Automatic Regulator" read at a conference on Automatic Regulators organised by the Chemical Engineering Group and held at University College, London, October 16, the chairman of the Group, Mr. Stanley Robson, presiding. This method, however, suffers from the disadvantage of requiring complete knowledge of each of the plant's stages and tends to produce equations of impracticable complexity when applied to temperature regulation.

Since most of the complication is due to combining in one equation the behaviour of the regulator and the fundamental properties of the plant, there is much to be said for a method which regards the plant as an indivisible unit and concentrates on the action of the automatic gear, leaving the plant's characteristics to be determined by a separate, and thus simplified, calculation or by direct experiment. The present method, in fact, goes a step further and considers the measuring and regulating equipment as part of the plant, thus avoiding the uncertainty with regard to the differences between the real and the observed temperatures.

Counteracting Deviations

With the possible exception of those cases in which the controller is primarily intended to vary the temperature in accordance with a predetermined cycle, a controller is installed to counteract or to minimise deviations of temperature from the required value. The sequence of the uncontrolled temperature deviations in the general case is quite irregular, and the typical temperature curve obtained in an uncontrolled plant can therefore be regarded only as some indefinite function of time. For convenience in building up formulæ this temperature curve will be written symbolically as

$$\theta = F(t) \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

It is not as yet possible to design a controller which will act before it notices a change of temperature, so the addition of a controller will not convert this irregular curve into the required constant or varying temperature line, and the final temperature record will still show irregular, but, presumably, smaller deviations which at this stage are easiest described as another function of time and denoted by the expression

$$\theta = f(t) \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

The algebraic difference between these two functions should now represent the effect of the controller, so that, denoting this difference by θ_z, we have

$$F(t) - f(t) = \theta_z \quad \ldots \quad \ldots \quad (3)$$

As the character of the movement imparted to the control valve depends on the measured temperature $f(t)$ and on the method of control employed, while the influence of this movement on the plant temperature depends on such factors as the rate of heat transfer and the heat capacity of the plant components, to show the dependence of θ on the factors enumerated it should be written in the form:

$$\theta_z = \Phi_1 [f(t), \text{method of control, plant design}].$$

Since, however, in a given installation the plant design and the controller design can be regarded as constants this expression can be reduced to a less cumbersome form:

$$\theta_z = \Phi [f(t)].$$

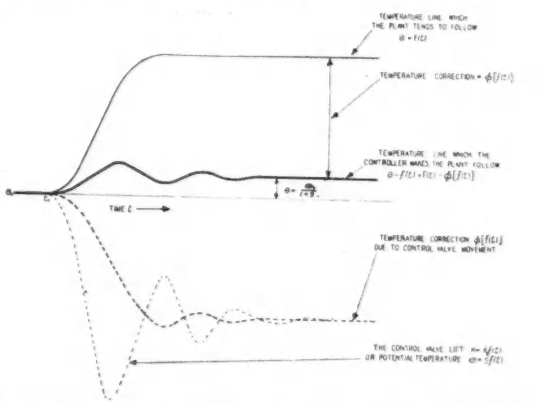
The equation (3) can then be written:

$$f(t) + \Phi [f(t)] - F(t) = 0 \quad \ldots \quad (4)$$

and used as the fundamental equation of the automatic control.

The accompanying graph shows the development of a temperature disturbance, the corresponding action of the recording controller and the resulting temperature curve. It is assumed that the *proportional* method of control is employed, in accordance with which the control valve is deflected from its mean position in proportion to the temperature deviation from the desired value. The temperature is set at θ_0, and to make the picture clearer this value is used as the datum line for plotting the valve position and the temperature correction θ_z.

It will be seen that the temperature is maintained at the correct value until the instant t_0 when a disturbance becomes visible *on the temperature record*. The temperature record which would have been obtained without the controller is


TEMPERATURE LINE WHICH THE PLANT TENDS TO FOLLOW
TEMPERATURE CORRECTION
TEMPERATURE LINE WHICH THE CONTROLLER MAKES THE PLANT FOLLOW
TIME t
TEMPERATURE CORRECTION DUE TO CONTROL VALVE MOVEMENT
THE CONTROL VALVE LEFT
OR POTENTIAL TEMPERATURE

shown by the thin line $\theta = F(t)$. As soon as the temperature begins to deviate from the datum line the controller begins to move the control valve in order to check the deviation. This movement is shown by the thin dotted line $H = -k_1.f(t)$. The effect of the plant lag, however, is to delay the effect of the control valve movement so that the temperature correction actually follows the thick dotted line $\theta_z = \Phi [f(t)]$.

Influence of Plant Lag

To show more clearly the influence of the plant lag the relative scales of the valve position and the temperature correction created are made to coincide. It will be seen that not only are the two displaced in time, but that the amplitude of the temperature correction swing is considerably smaller than the valve movement. As soon as the temperature correction begins to be felt the recorded temperature curve begins to depart from the curve which the plant would have followed if uncontrolled and follows the thick line:

$$f(t) = F(t) - \Phi [f(t)].$$

It will be noticed, however, that the final temperature does not return to the datum line Θ_0, but differs from it by a certain amount, which, as a matter of fact, is equal to $\Theta_0/(1 + s)$

where Θ_0 = total extent of the deviation.

s = controller *sensitivity*.

This discrepancy is a feature of the proportional method of control and can be reduced by increasing the value of the sensitivity s. If, however, the sensitivity exceeds a certain limiting value, which depends on the properties of the plant, hunting will occur. When the controller sensitivity is adjusted to a good average value the incipient oscillation quickly dies out as shown in the illustration.

For the ground work on which the use of the automatic control equations is based, the results obtained so far show that the temperature changes due to the combined effect of the disturbances and the influence of a controller are defined

by a general equation (4):

$$f(t) + \Phi [f(t)] - F(t) = 0.$$

The term $F(t)$ is arbitrary and can be varied to suit the student's purpose. The term $f(t)$ is the unknown, and therefore is denoted by the general equation

$$\theta = A_0 + A_1 \sin (mt - u_1) + \ldots$$

The term $\Phi [f(t)]$ embraces both the potential temperature, which varies with $f(t)$ in accordance with the method of control—say in proportion to it—and the relation between the potential temperature and the recorded wave. In a standard plant the relation between the wave of the potential temperature and the recorded temperature is based on the expressions:

$$\Theta = A.\sin mt,$$
$$\theta = A.e^{-c\sqrt{m}} \sin (mt - C\sqrt{m}) \quad \ldots (5)$$

An inquiring person, upon being confronted with the hundreds of proprietary automatic regulating devices, all claiming substantial improvement on the apparatus supplied by competitors, would be entitled to assume that the number of methods, modes or types of control is comparatively great. This, however, is not the case, since a consideration of the problem will show that there is a distinct limit to what the apparatus can measure and to the manner in which it can move the control valve.

Positioning the Valve

In fact the apparatus can measure the actual temperature *deviation*, the *integral* of the temperature deviation, and the temperature *gradient*. It is not so far practicable to measure the higher derivatives of the temperature curve, while the use of such freaks as the *square* or other power of the temperature deviation amounts to a modification of a method rather than a complete departure from it, and generally gives inferior results.

Having measured the desired properties of the temperature curve it is possible either to *position* the valve in proportion to it or to *move the valve at a speed* proportional to it. These alternatives can be grouped in a number of combinations, but as some of the combinations are theoretically, if not mechanically, equivalent to others the total number of basic methods is three. In accordance with these three methods the valve is *positioned* in proportion to (a) the actual *deviation*—in the *proportional method*, (b) the *integral* of the deviation—in the *floating method*, (c) the *rate of change*—in the *first derivative method*.

These three methods can be, and often have to be, combined with each other. For instance, in advanced designs the proportional method is combined with the floating, while the use of the first derivative alone without the addition of the floating method would lead to regulation which may be stable, but which would certainly be capable of stabilising at the wrong temperature.

Methods of Control

The characteristic equations which show how the potential temperature (*i.e.*, the valve position) varies in dependence on the measured temperature curve for the enumerated methods of control are as follows:

The proportional method: $\Theta = s.f(t) \quad \ldots \quad \ldots \quad (6)$

The floating method: $\Theta = S. \int f(t)dt \quad \ldots \quad \ldots \quad (7)$

The proportional-plus-floating method: $\Theta = s.f(t) + S. \int f(t)dt \ldots \quad (8)$

The first derivative-plus-floating method: $\Theta = \sigma \frac{d}{dt} f(t) + S. \int f(t)dt \quad \ldots \quad (9)$

The proportional method suffers from the disadvantage of allowing a change of conditions to cause a permanent, if small, deviation of the temperature from the value desired. Its sensitivity, however, does not require a very wide adjustment as it is the same for any standard plant, so that the adjustment needed is one compensating for any deviation of the plant from the standard behaviour.

The floating method always brings the temperature to the value desired, but, its period being considerably longer than that of the proportional method, it acts too slowly to be of much direct use in regulation of temperatures. For the same reason it allows a sudden disturbance to develop to great proportions before it arrests the trend of the temperature.

The combination of the two methods represents the best method so far commercially employed. After a disturbance it brings the temperature back to normal, and does so very quickly. This improvement is brought about by the increase of sensitivity of the floating method component made possible by the presence of the proportional method. Its natural period being near that of the proportional method, the oscillation does not take long to die out.

The first derivative method cannot be used alone as it is sensitive only to the temperature gradient, but not to its value. It is also insensitive to very slow changes of temperature, and thus does little or nothing to counteract gradual changes of conditions. When it is combined with the floating method the sensitivity of the latter can be considerably increased by comparison with the "floating proportional" combination, and the regulator then deals effectively with both slow and fast changes.

The Desirable Automatic Regulator

The most desirable type of automatic regulator, from the point of view of convenience, requires no outside source of power, and fulfils all requirements in 75 per cent. of the installations involving control at temperatures below 300° F., said Mr. B. T. Wingfield, of the Drayton Regulator and Instrument Co., Ltd., in his contribution to the symposium ("Applications and Limitations of Self-Operating Temperature Regulators") on October 16, Mr. W. A. S. Calder presiding.

Most self-operating temperature regulators have similar characteristics, although there are several operating principles; consideration will be confined to the vapour tension type, which is the one in most general use. Vapour formed by the heating of a volatile liquid is trapped in a bulb and exerts a pressure which exactly corresponds to the temperature of the medium surrounding the bulb. The pressure is transmitted through a connecting tube to a bellows housed in a casing above the valve, and so arranged that the movement of the bellows is opposed by a spring or weight. As the temperature for which the regulator is set is approached, the pressure generated by the volatile liquid rises sufficiently to expand the bellows against the resistance of the spring or weight and to operate the valve. With falling temperature the pressure decreases, and the valve moves in the opposite direction.

To adjust the temperature at which the valve operates, the spring tension is altered, in the case of spring loaded regulators, by means of an adjusting screw. With weight loaded regulators the position of the weight on the lever is changed.

The power available to overcome the unavoidable friction in the gland and valve unit is determined by the vapour tension curve of the filling liquid and the area of the operating bellows. If the influence of the characteristics of the spring and the bellows is neglected and the most favourable filling liquid has been selected, the minimum temperature differential required to reverse the direction of movement of the valve is determined entirely by the area of the bellows. The area, and consequent displacement of the bellows, in turn determines the size of the bulb required. There are a number of practical reasons why the bulb should not be larger than strictly necessary. The time lag of the instrument is governed by the relation of the bulb surface area to bulb volume. It becomes apparent, therefore, that a compromise between the

$F(t)$ = temperature in uncontrolled plant.
$f(t)$ = temperature in the plant when controlled.
S = sensitivity of the floating method of control.
s = sensitivity of the proportional method of control.
$\Phi[f(t)]$ = function of $f(t)$ governing the form of the correction applied to the plant.
σ = sensitivity of the first derivative method of control.
θ = temperature.
Θ = potential temperature.
θ_z = temperature correction created by the controller.

practical plant considerations and considerations governing the instrument characteristics is generally essential.

The bulb design can be adapted to meet varying conditions. Where air or gas temperatures are controlled, the rate of heat transmission is in any case relatively low. For such applications it is usual to utilise bulbs of small diameter and increased length in order to improve the relation between the surface area and volume of the bulb. But, even by these means, it is not possible to reduce the time lag to that of relay operated regulators of the expansion stem type. Where the conrolled air or gas is in rapid motion, conditions become less unfavourable. It is, however, in the application of self-operating regulators to the control of air or gas temperatures that most disappointments occur.

Friction of the Valve Unit

The temperature change, with any given filling liquid, required fully to open or close the valve is determined by the rate of operation of the spring added to the rate of the bellows in relation to the area of the bellows. To this figure, which can be easily determined theoretically, must be added the friction in the valve unit already mentioned.

The valve friction and spring characteristic of the bellows generally account for a minimum temperature differential between fully opened and closed of 2—2½° F., although this figure can be considerably reduced by careful gland adjustment. Adding to this figure the increase due to spring rating, a usual differential between fully opened and closed for valves up to 2 in. diameter is 3 to 3.5° F., but is slightly higher for larger valves. In cases where the load may fluctuate within wide limits, corresponding to practically full open and closed positions of the valve, this figure of 3.5° F. represents the tolerance which must be allowed for variations in temperature. Where small variations only in load occur and conditions are otherwise favourable, closer control will be obtained down to 1—1.5° F., which represents the temperature difference required to reverse the movement of the valve due to frictional causes.

The most favourable conditions, from the point of view of close control, for the installation of a temperature regulator occur in a liquid container having a large volume in relation to the demand for steam, and having good circulation or turbulence to ensure an even distribution of heat. Such conditions are usually found to apply to storage calorifiers, dye vats, boiling kettles, and similar apparatus. Changes in temperature occur slowly, not only allowing for any lag in the controlling instrument, but also for the effect of the time interval between the movement of the controlled valve and the resulting change in temperature at the point at which the bulb is installed.

Where adequate heat storage cannot be provided the inherent time lag of the regulator can be reduced by securing turbulence of the controlled fluid. In this way the rate of heat transfer between the fluid and the sensitive bulb can be accelerated. This turbulence is of particular importance where the controlled fluid is one having a low factor of heat transfer, such as oil. When air or gases have to be controlled it is often necessary to secure sufficient turbulence by means of fans in order to obtain a satisfactory rate of heat transfer.

Referring to some further points in regulator design, which materially affect their application, Mr. Wingfield said the most common operating condition in the case of the vapour tension regulator is that in which the bulb is at a higher temperature than the connecting tubing or operating bellows; the bulb is partly filled with liquid, the connecting tubing and bellows being completely filled with liquid. It is, however, possible to construct the regulator to operate with the bulb at a lower temperature than the transmitting system.

Another Difficulty Arises

Where the operating system may be alternately at a higher and lower temperature than the bulb, considerable difficulty arises. The bulb has to be made sufficiently large to supply not only the displacement of the bellows but also to receive or supply, alternately, the quantity of liquid contained in the connecting tube and bellows. As the temperature of the operating system changes over the critical point, a very considerable time lag is experienced while the liquid passes between the system and the bulb. This often makes a vapour tension regulator of standard construction impractical.

Self-operating regulators usually have not sufficient power to operate single-seated globe valves, except in small sizes and against low pressures. It is therefore necessary in most cases to employ balanced valves, the most usual being the double-seated type. Owing to differences in expansion between the valve body and valve stem, however, the degree of tightness obtainable under varying conditions is limited.

The Education of the Chemists

From Cradle to Retirement

THE education of the chemist was the subject of a symposium at a joint meeting of the Edinburgh and East of Scotland Sections of the Institute of Chemistry and the Society of Chemical Industry, at Edinburgh, on October 15.

Dr. W. G. Hiscock, who opened the symposium, said in most cases the chemist's education commences in the cradle and terminates when he retires. In his view there were three very distinct periods in this evolution, *viz.*, Period 1, involving parental and school education; Period 2, involving intensive chemical education; Period 3, involving industrial education during employment.

There are mainly two methods by which the mass produced school boy, having obtained the necessary specification, may receive the intensive education required to permit his entry into industry as a chemist. He must enter either (a) an industrial laboratory as an "apprentice" or "assistant" and study in his spare time, or (b) a university. In either case he must obtain a recognised qualification by examination before he is considered a chemist.

The laboratory apprentice method should be restricted as much as possible. It certainly allows boys to reach the status of a chemist whilst they are supporting themselves, and gives industry a class of worker particularly fitted to carry out routine analysis and investigations, but it does its utmost to destroy the character of the boy, stunt his development and break his spirit. Just ponder for a moment and consider what this system demands of the boy. In general he spends day after day in an industrial laboratory from 9 a.m. until 5 p.m., carrying out routine work which is usually very quickly mastered and then becomes boredom. He has then to go to evening classes and cram into his brain, tired through boredom, all that his more fortunate counterpart, the undergraduate, has the whole day to do. His revision and reading can only be carried out at the weekend. Dr. Hiscock's most serious objection to this method of education of the chemist is that during these impressionable years he has to obey implicitly the instructions of his superior authority, perhaps intellectually his inferior. Initiative in an assistant is usually suppressed. The result of this is that the lad develops a serious inferiority complex which is often retained throughout life.

The normal method of meeting the needs of industry in

its demands for chemists by university post-graduates, however, is fundamentally sound. The graduate very rapidly settles down, and very soon carries his weight. This is attributed to the fact that during his university life he has obtained a certain *joie de vivre,* a certain "equality complex" in relation to his fellow human beings and a "superiority complex" in relation to his job of work, both so essential in the battle of life. He has absorbed his technical knowledge in surroundings conducive to study, competing with friends with similar interests and intelligence, and, perhaps most important of all, with the opportunity and time to engage in organised games and recreation so essential in developing the body at this very critical age; he has also been a member of college societies, the conducting of which has introduced him into procedure which he will meet in everyday life.

A Good Personality

A good personality, with an all-round education, is particularly desirable in chemistry, continued Dr. Hiscock. By an all-round education the chemist-to-be should have: (a) Good knowledge of his mother tongue, so that he can thereafter express himself clearly (this is usually developed at school, but universities can help in correcting written work). (b) A general knowledge of chemistry with particular attention to the development of the science from first principles. (c) A knowledge of the subsidiary subjects, physics and mathematics, particularly from a point of view of developing the reasoning faculty (these subjects should be taught and studied right up to the student's entry into industry. (d) An ability to read French and German.

Industry requires some specialists amongst its chemists, the most important of whom are those versed in chemical engineering and those trained for research work. Such specialising should take place as post-graduate courses.

It is as much an essential factor of industry to educate its employees as it is to keep its plant in a satisfactory state of repair. The ambitious streak in human nature supplies the necessary urge in seeking promotion. Once the gate of industry has been entered the chemist, if he be wise, does not rest on his oars and say: "I've a job; my 'swotting' is over; I know all there is to know; I can teach this outfit real chemistry." He will realise his limitations, that he has new fields to conquer, new friends to win over, who are practised in solving urgent problems, giving immediate decisions, and versed in measuring results in £ s. d. These friends may be modest process workers, but if he can master the art of winning them to his side, his foot is on the first rung of the ladder.

The Continuation of Education

Industry to-day provides every facility for the continuation of the education of its staff. Very little is kept secret, and it is made the duty of those in charge to keep those responsible to them *au fait* with the progress that is going on. Libraries are maintained in an up-to-date condition, journals of learned societies, trade and professional periodicals are all available to the staff. Confidential information is even given a wide circulation throughout offices, works and laboratories. In certain cases members of the staff are sent to the university to be taught special methods or work at specific problems under the guidance of a professor, and in districts remote from large centres, facilities and financial assistance are given to encourage technical discussions and provide lectures on professional subjects.

The function of the school is not to train chemists, but to fit men and women to lead "the good life" in the modern democracy, said Dr. William. P. D. Wightman, in a further contribution to this symposium. Only after the leaving examination has been passed should some specialisation be allowed; for the stimulus of a clearly focused professional aim often causes the blossoming of a student who had responded little to general schooling.

A school science course should aim at putting the child in a position to seek answers to *his own* questions, such as "why things burn," and "why they float," and how all things "work together in harmony." Interest should be maintained by withholding—as Nature withholds— the complete answer, which will gradually emerge only as the problem is viewed from the different standpoints of the several sciences. Let science teaching also give the pupil as many opportunities as possible of judging evidence in as many fields as possible, so that he may learn to distinguish between facts, hypotheses and "mere lies." Finally let the historical approach be freely used.

Many Kinds of Chemists

There are many different kinds of chemists, but there is only *one* science of chemistry, therefore a thorough knowledge of that science must be acquired by all qualified chemists, said Dr. David Bain in his contribution to this symposium. For that knowledge of chemistry, mathematics and physics are essential, as they make a wide and deep foundation to carry the superstructure of the many different branches of chemistry. For an educated chemistry profession a knowledge of these three sciences is the minimum requirement and to no extent may they be replaced. Whatever additional studies must be taken up to suit a particular industry or profession these studies must be superimposed on these three fundamental sciences. In a four years' degree course these three sciences would occupy in the time table one year of mathematics, two years of physics and three years of chemistry. In the case of the research chemist the remaining time available would be devoted to the study of a related science, to research, to private reading and to a few special lectures. In the case of the chemist destined for the work's side of the chemical industry the corresponding time would be devoted to special courses.

During the first years of his training the student is learning his profession—he is spoon fed—he has used his memory, but may not have had much time to use his brains. In his final year the important thing to aim at is the development of the student's faculty of *investigation* so as to extend his powers of manipulation, observation, clear and logical reasoning, and ability to record his observations and conclusions rather than simply accumulating facts. The pure science student can do that in his research work and the works chemist in tackling industrial problems. It is the manner in which a problem is attacked and not the problem being investigated that matters.

A Formidable List of Duties

Speaking of the chemist in the chemical industry, and particularly the works chemist who represents no small proportion of the number of qualified chemists, Dr. Bain said the duties of a chemist in a large chemical industry could be classified as follows:—

Class I.—Fundamental research (academic research)—work not concerned immediately with the works processes.

Class II.—Research on works processes, examination for improvement of quality and yield, material cost. Wrongly called technical chemists.

Class III.—Works chemist—carrying out process according to recipe, operating plant intelligently, involving theoretical and practical knowledge of all the plant. Knowing the efficiency of the plant. How the efficiency can be improved. Watching repairs and getting over excessive repairs. Concerned with service and labour costs; proper allocation of labour by devising "time cycles"; protection of workers against accidents and injury to health; sufficient engineering knowledge to talk intelligently to the engineer. He must also make a study of the workman and make himself respected by him and by his colleagues in the engineering, costing, analytical, stores and research departments with whom he must work harmoniously.

In the case of the smaller chemical industry in which only one or few chemists are employed the chemist has to carry out the combined duties of the research and the works chemist.

The Conversion of Coal into Liquid Motor Fuels

The Melchett Lecture Delivered by Professor F. Fischer

TWENTY-FIVE years ago the distillation of coal and bituminous rock either at high or low temperatures was, apart from mineral oil, the only available source for the production of liquid fuels and other chemical products, said Professor Dr. Franz Fischer, of the Kaiser Wilhelm Institut, Mülheim-Ruhr, in delivering the Melchett Lecture before the Institute of Fuel on October 15. In addition to tar and benzole, by-product ammonia played a prominent part at that time, but its importance to-day is largely overshadowed by the manufacture of synthetic ammonia. Twenty-five years ago, however, nothing was known about the hydrogenation of coal at high pressure, by which coal is almost completely converted into liquid hydrocarbons. Although at the beginning of this century Ipatieff had succeeded in hydrogenating a number of organic compounds at high pressure in the presence of catalysts, no attempt had been made to tackle the problem of high-pressure hydrogenation of raw coal, which was first successfully accomplished by Bergius in 1913.

Raw Material of Chemical Synthesis

As coal consists of a mixture of different compounds, mostly unknown except in character, its distillation or hydrogenation cannot be expected to yield definite chemical compounds or those of a uniform chemical character, and consequently the tars and oils produced by hydrogenation possess a complex composition. In the distillation of coal the bitumen and the unstable constituents of the tars undergo a cracking process. Similarly, high pressure hydrogenation of coal can be regarded as a combination of hydrogenation and cracking or as destructive hydrogenation (Abbau) resulting in the formation of compounds of lower molecular weight than those contained in the original coal.

Synthetic processes (Aufbau), which have ben developed in the past 25 years, utilise with advantage carbon monoxide as raw material. It is readily obtainable and, indeed, on a scale of almost unlimited magnitude by the gasification of practically any type of coal or coke in the water gas process, which, particulary in England, has reached a high dregree of perfection as an automatically operated process. The carbon monoxide is produced in the water gas process simultaneously with hydrogen, by an endothermic reaction. The gasification of coal thus yields carbon monoxide, a chemically well-defined compound, which has the advantage of being entirely free from ash and which can be purified without much difficulty. It is thus attractive as a raw material for synthetic processes and is, therefore, used by the chemist rather than coal. Its high reactivity has long been known. Everybody is familiar with the formation of alkali formates and thus of formic acid, the formation of additive compounds, such as from chlorine and carbon monoxide forming phosgene, and the synthesis of methane, discovered by Sabatier in 1902.

Synthesis of Hydrocarbons

All these reactions, however, produce compounds containing not more than one atom of carbon, so that they cannot be regarded as syntheses of a hydrocarbon series. Likewise, the metal carbonyls, the discovery and technical exploitation of which is associated with the name of Mond, contain, notwithstanding their content of more than one carbon atom in the molecule, no carbon groups which are characteristic of the synthesis of hydrocarbons.

The first reliable data concerning the formation of hydrocarbons from carbon monoxide and hydrogen are contained in the patents of the Badische Anilin und Sodafabrik of 1913. When, according to these patents, catalysts are used at temperatures of about 400° C. and at pressures of 100 atmospheres (1,420 lb. per sq. in.) and more, hydrocarbons and their oxygen derivatives of a wide range of boiling points are obtained. From these patents the I.G. Farbenindustrie developed later the high-pressure synthesis of methanol from carbon monoxide and hydrogen.

In the years 1922-23, said Professor Fischer, he found, in conjunction with his collaborator, Tropsch, that in the presence of an alkaline iron catalyst at a temperature of 400° C. and at a pressure of 100 atmospheres (1,420 lb. per sq. in.) oxygenated compounds are produced, which consist of alcohols, adrehydes, ketones and fatty acids. Actually, about 17 individual compounds were isolated and identified. The mixture of these oxygenated compounds produced at high pressure was called, for the purpose of simplicity, " Synthol." In conjunction with Zerbe, he also found that as the pressure falls, but under otherwise similar conditions, compounds containing less and less oxygen are formed. At 7 atmospheres (99.4 lb. per sq. in.) an oil is obtained which consists principally of hydrocarbons of paraffinoid character. At the same time the rate of reaction falls progressively with the reduction in pressure. This discovery pointed to the fact that the synthesis of pure hydrocarbons from carbon monoxide and hydrogen must be carried out without the application of pressure, and it became necessary to develop catalysts which at atmospheric pressure possessed sufficient activity to counteract the reduced rate of reaction.

In 1925 Tropsch and Fischer were able to record the first success at atmospheric pressure. It became evident that in order to ensure that the already highly active catalyst maintained a fairly long life it was necessary to work at low temperatures, namely, between 200 and 300° C. instead of 400° C. This reduction in temperature slowed down the reaction velocity still further, which again had to be counteracted by an additional increase in the activity of the catalyst.

Purification of the Process Gases

At a scout plant erected at the Institute two problems important to the petrol synhesis received attention. In the first place, it was necessary to purify the water gas, or the final mixture of gases ($CO+2H_2$) as required for the synthesis, sufficiently from organic sulphur compounds to ensure a long life for the catalyst—the sulphur content of the gas must not exceed 0.2 gram of sulphur per 100 cu.m. (0.087 grains per 100 c. ft.). After much painstaking research Roelen developed a satisfactorily cheap process which meets the conditions imposed by the hydrocarbon synthesis.

The other problem which had to be solved arose when the laboratory results were translated to a plant of 2,500 times the size of the laboratory apparatus, where the process, however, was still operated on a small scale. While the water gas process, using, for instance, coke and steam, is strongly endothermic—that is to say, consumes energy (heat) in the production of hydrogen and carbon monoxide—the formation of aliphatic hydrocarbons, as, for instance, " gasol," petrol, Diesel oil, paraffin waxes, is exothermic—that is to say, liberates energy. When the conversion is complete, the heat of formation amounts to no less than 20 per cent. of the potential heat of the gas, corresponding to about 600 calories per cu.m. (67.3 B.Th.U.s per c. ft.). This amount of heat is sufficient to raise the temperature of the gases by several hundred degrees C., whereas the synthesis demands 190° C. as the optimum temperature, and permits very litte variation from this optimum. Many types of reaction chambers were designed in which the dispersion of the heat of reaction was attempted in various ways—for instance, by cooling with air, by circulation of the diluted process gases, by moving the catalyst, with the aid of superheated water, and the circulation of oil. A number of these designs have been published but not the final construction, which was handed over to the Ruhrchemie A.G.

As far as the manufacture of the process gases is concerned, it is essential that they have a higher hydrogen content than ordinary water gas. Such gases can be produced by several old and new processes which use coal, semi-coke or high-temperature coke as raw material. The process developed by Pichler and Fischer, for use on both the small and large scale, produces direct a gas containing carbon monoxide and hydrogen in the ratio of 1 CO : $2H_2$ at a minimum consumption of coke. It has been designed with a view to establishing the process at coking plants, and differs from the ordinary water gas process in that during the gas-making period, instead of steam alone, a mixture of steam and coal gas is admitted to the generator. The methane of the coal gas being converted into carbon monoxide and hydrogen in the ratio of 1 :3 raises, together with the hydrogen already contained in the coal gas, the hydrogen content of the water gas, so as to produce the desired ratio of 1 CO : $2H_2$.

Operation of the Process

The operation of the process consists of :—(1) Production of water gas or mixture of gases containing CO and H_2 in the ratio of 1 :2; (2) preliminary purification from dust; (3) purification from hydrogen sulphide by any of the existing processes; (4) final purification from organic sulphur compounds down to 0.2 gram per 100 cu. m. (0.087 grains per 100 c. ft.); (5) passage of gas through the reaction chamber; (6) condensation of water and oil; and (7) recovery of petrol and " gasol " from residual gas by means of active carbon. The final purification of the gas, the composition of the catalyst and the design of the reaction chamber fitted with suitable devices for the dispersion of the heat of reaction, and thus for the maintenance of a constant temperature, are the special features of the process.

Theory of the Process

The hypothetical reaction $CO+2H_2=CH'_2+H_2O$ yields in the first place one CH'_2 radical and one molecule of water, in the presence of cobalt or nickel catayst. When iron catalysts are used, which require a higher temperature, the molecule of water probably first formed reacts immediately with a second molecule of carbon monoxide, forming hydrogen and carbon dioxide, so that the equation becomes

$$2CO+2H_2=CH'_2+H_2+CO_2.$$

The practical application of this reaction, consisting in the use of an iron catalyst and a gas containing $2CO+1H_2$, which would form CH_2+CO_2, failed owing to the short life of this type of catalyst in such a gas. The fact that our process can only utilise catalysts containing a metal of the eighth group of the periodic system as principal metal, and the fact that carbides are present in the used catalyst, gives ground for the assumption that a carbide is first formed by the interaction of carbon monoxide and the principal metal, which yields by a secondary hydrogenation the CH_2 radicals according to the equation

$$CO+2Me=MeC+Me\ O$$

The function of the hydrogen therefore consists of regenerating the basic metal, whereby simultaneously one CH'_2 radical and one molecule of water are formed:

$$MeC+MeO+2H_2=2Me+CH'_2+H_2O$$

It is probably more correct not to assume the alternate formation of carbide and metal, but rather the alternate formation of carbides of higher and lower carbon content.

In any case, it can be assumed that the CH'_2 radical is the primary material which gives rise to the formation of aliphatic hydrocarbons. As the result of polymerisation, which in this case means the building up of carbon chains from radicals, aliphatic hydrocarbons are formed. According to operating conditions they may be either saturated or simple unsaturated compounds—that is to say, paraffins or mono-olefines or mixtures of them. These compounds may contain many more than 50 carbon atoms in the molecule and possess a melting point of over 100° C.

Operating conditions vitally affect the velocities of the polymerisation and the hydrogenation process. If the latter is high, the CH'_2 is at once hydrogenated to CH_4, and polymerisation is no longer possible. If, however, the velocity of hydrogenation is low, homologues of methane are formed. The more the velocity of hydrogenation falls and the more the velocity of polymerisation is increased by special measures, the higher is the yield of high boiling olefinic compounds. If it is therefore intended to influence the type of product obtained, the two reaction velocities must be suitably adjusted either by chemical or physical means.

The suggested control of the process by physical and chemical means, said Professor Fischer, is still a hypothesis, which remains to be proved; but it is feasible. It is also possible to assume that large molecules are first formed from the CH'_2 radicals. These high molecular paraffins and mono-olefines are solid at room temperature and are deposited on the catalyst on account of their low vapour pressures. The size of these molecules is restricted, on the one hand, by their thermal stability—that is to say, their stability at 190° to 200° C,. and, on the other hand, by their resistance towards hydrogenation in contact with a catalyst and the hydrogen of the process gases. According to this hypothesis, the assumption is justifiable that first exceptionally large molecules are formed, which become smaller as the result of hydrogenation, until they are so small that their vapour pressure is such that they can be carried away from the catalyst by the process gases passing over it. In this way the saturated compounds of the light spirit and Diesel oils could be obtained, whereas the thermal decomposition of the large molecules would also produce mono-olefines.

Products of the Catalytic Reaction

In the operation of the process which has been adopted up to the present, the reacting gases pass over the catalyst only once. This simple procedure has been possible, because the equilibrium in the formation of aliphatic hydrocarbons from carbon monoxide and hydrogen at a temperature of about 200° C. shows a predominant tendency towards the hydrocarbons. Under these conditions the process yield amounts to 110 to 120 grams of hydrocarbons per cu. m. of gas (6.8 to 7.5 lb. per 1,000 c. ft.), consisting of " gasol," petrol, diesel oil and paraffin waxes.

It is possible to increase this yield so that it almost approaches the theoretical yield, but the process becomes thereby more complicated. The relative quantities of " gasol," petrol, diesel oil and paraffin waxes are, for instance, as follows, in per cent. by weight: " Gasol " 8, petrol (boiling up to 200° C.) 62, Diesel oil 24, paraffin wax 2, ceresin 4. The relative yields of the individual constituents, however, can be varied by altering the operating conditions; petrol is at present the principal product. The gasol is recovered from the residual gas, the paraffin wax from the oil, while the ceresin, which has a melting point of over 80° C., is extracted from the catalyst. By suitable treatment the raw product can be split up into synthetic ceresins of melting points ranging from 100° to 120° C., which are unique in character.

A High Degree of Purity

All the products possess a high degree of purity and a pleasant odour. They are colourless and entirely free from sulphur, so that they require no further treatment, except a wash with alkali in order to remove traces (a few tenths of 1 per cent.) of fatty acids.

The boiling-point curve of the petrol is quite smooth. When petrol is used in a modern internal combustion engine, it is important to know whether the anti-knock properties of the petrol and thus its octane number can be improved. The petrol and Diesel oil, like the other products, consist mainly of aliphatic hydrocarbons, in which the carbon atoms form a straight chain. This constitution is an advantage in the case of Diesel oils, but it is not desirable in the case of petrol, as the higher boiling constituents posses no anti-knock properties. Since the petrol motor uses the lower boiling fractions, whereas the Diesel motor runs on those of higher boiling

point, it is only necessary to improve the anti-knock properties of the lower boiling fractions. The object can be achieved in different ways, as, for instance, by the addition of alcohol, as prescribed by German law. Likewise, benzole or benzole and alcohol can serve the same purpose. The addition of 0.5 c.c. of tetra-ethyl-lead per litre—that is to say, 0.05 per cent. by volume—raises the octane number of the petrol to a sufficient degree.

Diesel Oil

As already mentioned, the higher boiling fractions of the product (up to about 300° C.) are on account of their chemical constitution the best type of fuel for Diesel engines, particularly high-speed engines. It has been found that the calorific value of these oils is approximately 10,470 calories per kg. (18,846 B.Th.U. per lb.) and that the consumption per h.p. hour is less than 190 grams (0.42 lb.). It is known, however, that aircraft Diesel motors exist which use not more than 170 grams (0.375 lb.) per h.p. hour of ordinary Diesel oil, so that the consumption in the case of our Diesel oil with its high hydrogen content should be less. The Diesel oil "Kogasin II" possesses excellent combustion properties, gives a clear exhaust even in the case of overload, and causes no knocking, which usually occurs in Diesel engines, being ascribed to delayed ignition.

With regard to the low-temperature properties of the petrol, "Kogasin I" and the Diesel oil "Kogasin II," it has been found that the solidifying point of the former is below −60° C., and that the solidifying point of the Diesel oil, from which the paraffin wax is removed by freezing out, is below −30° C.

Lubricating Oils

The task which Professor Fischer and his collaborators set themselves was the production of motor fuels from coke or coal by way of carbon monoxide, but the solution of the problem would have been incomplete if Herbert Koch and Fischer had not found a material in "Kogasin" which can be converted by means of old or new methods into lubricating oils. The material is the mono-olefines contained in "Kogasin." The conversion of these olefines into lubricating oils can be effected, for instance, by the addition of a few per cent. of aluminium chloride, according to an already known method.

The examination of the individual fractions of "Kogasin" reveals that their olefine content increases with a fall in the boiling point of the fractions. The oils, which have been produced by the polymerisation of the olefines contained in individual fractions, possess extraordinary characteristics, inasmuch as in spite of their uniformly low specific gravity of 0.83 to 0.85 certain fractions yield lubricating oils which show a very small change of viscosity under the effect of temperature, a most desirable feature.

Carbon monoxide is not only an important raw material for the synthesis of petrol, Diesel oil and lubricating oils, but also for the manufacture of other products essential to the motor industry. One's mind naturally turns to synthetic rubber, whose importance in connection with road vehicles need not be emphasised. The acetylene required for the process can be obtained from carbon monoxide through the "Kogasin," which is easily split into ethylene or acetylene and other products. A further possibility is the production of carbon black, which is extensively used in the rubber industry, by the decomposition of carbon monoxide under suitable conditions, according to the equation

$$2CO = C + CO_2.$$

There are already some indications that "Kogasin," "Gasol," petrol and paraffin waxes lend themselves to further chemical treatment, which opens a wide field in this industry, particularly on account of the high degree of purity and uniformity of "Kogasin" products.

Synthetic processes starting from carbon monoxide are already of interest to countries possessing coal, but which have few or no natural resources of mineral oil; in the perhaps not far distant future they may play some part in countries which possess not even peat. The carbon dioxide in the air or issuing from the ground is easily converted into carbon monoxide either catalytically with hydrogen in the presence of a copper catalyst at low temperatures, or with hydrogen and the aid of electric current as the source of heat supply. The necessary hydrogen, like the hydrogen required for the synthesis, can be obtained by electrolysis, for which purpose water power and other natural sources of power can be used. It is thus possible to produce any kind of fuel by means of the "Kogasin" synthesis, even if the time should come when neither coal nor oil are any longer available.

Letter to the Editor

Gas and Fire in the Next War

SIR,—Great preparations are now being made by a responsible Government Department to meet the menace of gas in the next war. The preparations now being made are doomed to failure. Firstly, the preparations are being made in terms of the last war, instead of a future war in which mustard gas and high explosive incendiary bombs will be the chief weapons used against the civil population, and the gas masks are of the usual rubber and canvas type, of which 20 million are now being made. These will be packed away in cases until required, and when that time arrives about 50 per cent. of them will not be in a serviceable condition. Secondly, the gas mask of the respiratory type will afford no protection against mustard gas. It will be impossible to wear a mask in a street drenched with mustard gas. Coupled to this nightmare will be the high-explosive thermite bombs. These bombs will be more effective than the bombs used by the Zeppelin and by other raiders. Water will be useless in quenching the flames; the heat from the thermite compound is so intense that water is converted into steam before it reaches the source of the fire. The ordinary fire-fighting apparatus will be useless, and yet no attempt is being made to augment the fire-fighting services, by creating a reserve, like the specials in the Police Force. Mustard gas and fire will be the menace to London. Previous air raids on London have been carried out with shrapnel and high explosive bombs, but the high explosive bomb of to-day has a greater bursting velocity. It is time that the Government appointed a board of expert chemists to deal with the problems of air attack instead of leaving it to office jacks. A proposal was put forward for gas victims to be treated in pharmacies. This idea is the height of nonsense and stupidity, as pharmacists have no knowledge of first-aid and are certainly not qualified in chemistry to deal with gas in any way, or its effects. Another proposal was put forward by a woman on one of the borough councils to evacuate the population in motor cars, buses, etc. What a target! What confusion and slaughter! Think of the congestion of traffic in London when workers are homeward bound in buses, trains and private cars. The idea is hopeless.

How long will it be before the Government wakes up to the terrible danger of mustard gas, and appoints men who are qualified to deal with it, who, by their profession and training, know the nature of the gas and its deadly effects, and who know how to counteract its effects.

The public should be told how to render themselves immune from mustard gas. This can be done at short notice, and would greatly reduce the work of the first-aid squads and emergency stations. Reorganisation of the fire brigade is absolutely essential. Five squadrons of light fast bombers could destroy London in a single attack by using the combined weapons of mustard gas and thermite bombs, also the inflammable liquid bomb using sulphuric acid as the source of ignition. At the moment of writing, after making inquiries, I find that the Government is appointing men to lecture on poison gas—men who are not chemists and who have no previous knowledge or experience of poison gas or chemical warfare. I suppose it is the usual British way.—Yours faithfully,

HUGH G. CORR.

Building and Equipping a New Factory—I.

By J. H. WEST, M.I.Chem.E.

THANKS to the improvement in trade the building of new factories or the provision of large extensions to existing factories is now an everyday occurrence throughout this country. Except in the case of the very largest companies such an event is rare in the history of any individual concern. Consequently, the directors and technical staff, having had no direct experience to go upon, are apt to be rather hazy as to what exactly is involved in such an undertaking and how best to set about it.

When directors have made up their minds to go ahead they are invariably in a great hurry to get started, and they cannot wait until the necessary lists of plant, buildings and equipment, together with the specifications and drawings have been prepared, inquiries sent out and quotations received. Hence, estimates are prepared which necessarily involve a certain amount of guesswork. To be of any real use, such estimates must be prepared by people who have had long experience of such work and are in close touch with current prices. If the work is done by inexperienced people the result is certain to be unduly optimistic, and as a result the company, before it has finished, may find itself let in for a far higher expenditure than was anticipated.

Primary Information

Even the expert estimator will need certain primary information to enable him to prepare a reliable estimate, and the more detailed the information at his disposal the closer he will get to the correct figures and the less he will need to cover himself by the addition of a heavy percentage for "contingencies."

The information which should be available at this stage is as follows:—

(1) A site lay-out showing the sidings, roads, buildings, points of entry of water supply, electric and gas supplies (if any), effluent and sewage outfalls, and the general run of underground pipework, including drains.

(2) Particulars of the dimensions of the various buildings, length, breadth, number of floors, height to eaves, and floor loadings; decisions regarding the type or types of buildings to be used, *i.e.*, whether steel framed encased in brickwork, steel framed with brick panels, ferro-concrete, etc.

(3) Particulars of the services required and their distribution to the various buildings, *e.g.*, quantities of steam per hour at various pressures, electric power, feed and cooling water, etc. This information should be supplemented by charts or curves showing the load factor and times of peak load throughout the day and week for all services both in summer and winter.

(4) Complete lists of all the plant and equipment required, so far as is known at this stage.

Methods of Carrying Out the Work

The next thing to settle is how the work is going to be done. There are various ways, and the one most suitable to the given case should be selected. This will depend largely upon the extent and calibre of the technical staff which the company has at its disposal or is prepared to engage specially for the job. The principal methods are given below with their comparative advantages and disadvantages.

As one course, the whole job may be placed in the hands of a firm of consulting engineers and architects, who will prepare all drawings and specifications, place all contracts, and be responsible for the proper carrying out of the work at all stages. Provided that a reliable firm of consultants, who have had considerable experience of factory building and equipment, and not merely of civil engineering jobs, is selected, this is a satisfactory and trouble-saving method. It is not, however, a cheap one, for besides having to pay the consultants a fee usually represented by a percentage on the total expenditure, there is not the same inducement on the side of the consultants to buy cheaply and keep down expenditure that there is when the company buys or places contracts direct. There is also inevitably a certain waste of time in passing over technical information to the consultants, getting back their proposals and checking over and approving or modifying these. On the other hand, a great deal of work and responsibility is taken off the company's own staff, and the necessity of engaging extra staff to do the work is avoided.

In other cases the company places all contracts both for buildings and plant direct; their technical staff prepare all drawings (apart, of course, from contractors' drawings) and specifications and supervise all work on the site, thus making themselves responsible for the correct carrying out of the work. This arrangement has the advantage that no consultants' fees are payable, and that the directors of the company are in a much better position to control expenditure and make sure that contracts are placed on the most advantageous terms. There is also a considerable saving in time provided, of course, that an adequate and efficient staff is available to cope with the work expeditiously. On the other hand, there should be a clear understanding beforehand of the very great amount of work which has to be done in a very short time. Directors are very prone to underestimate this and to expect rapid progress with a hopelessly inadequate staff. This question will be referred to again later on when we have discussed in detail the work to be done.

There are, of course, various intermediate arrangements between these two extreme methods. For instance, an architect may be employed to look after the building work only, while the company takes on the plant and equipment; or a firm of consultants may be called in to handle the power house and boiler house, or the construction of a deep water wharf, or some other specialised part of the work. The help of specialists who are not consultants can often be made use of. For instance, some of the reinforced concrete specialists will undertake the design of reinforced concrete foundations and provide working drawings, provided the reinforcing steel is obtained from them, and the big steel structural firms will always be prepared to design steel framed buildings to any given requirements.

Main and Sub-Contractors

Sometimes it is considered preferable to employ, either directly or through consultants, one main contractor, and to leave to them the placing of sub-contracts for all parts of the work which they cannot themselves undertake. This method saves trouble but costs more, because the main contractor will expect a profit, usually a percentage agreed upon beforehand, on all sub-contracts, and direct control of expenditure is more difficult. In such cases it should, of course, be laid down that competitive tenders obtained by the main contractor should be submitted to the company, who will decide which tender is to be accepted. In other cases there is a main contractor for the building work, and possibly a main contractor for the plant and equipment, or the plant and equipment may be split up into a number of separate contracts.

As regards the erection of the plant and equipment this can be done entirely by the company if they are prepared to engage the necessary men, or erection may be included in the contracts for the supply of plant and also such items as pipework. It is, however, extraordinarily difficult so to link up all the contracts (there may be anything from 30 to 50 or more contractors or sub-contractors on a large job) so that there are no gaps. It is practically essential that the company should have a gang of their own men towards the end of the erection stage.

Having settled the question of how the job is to be handled, the next thing is to get out a time programme aiming at a definite date of completion either for the whole factory, or for each section if it is desired to have some specially urgent section or sections ready before the whole.

It will always be found that there are certain controlling factors by which the date or dates must be fixed, *i.e.*, the things that take longest to get ready. If the buildings are of a solid and permanent type, involving much brickwork and are of large size and height, they will take longer than anything else. The boiler house and power house will certainly take a long time owing to the very long delivery times required for boilers and turbo-generators, and the large amount of auxiliary apparatus to be put in after these are delivered. Then there may be some large and heavy items of plant such as rotary driers which again will take a long time to get.

The item which is going to take longest obviously fixes the date of completion for the whole factory or the section, as the case may be, provided that a temporary makeshift cannot be used in the meantime. It happens sometimes that it is of the utmost importance to get a new plant running at the earliest possible moment, almost regardless of expense, in order, say, to capture a new market. For instance, some few years ago the writer, who was then in charge of the building and equipment of a large chemical factory, was told that the first section must be ready in five months without fail, and both steam and power were required for this section. He knew that the boiler house would not be ready for at least eight months and the power house for ten months. He got over the steam difficulty through the lucky chance that the factory of an associated company nearby had spare boiler capacity, and all that was necessary was to run a few hundred yards of pipe-line. Power was provided by buying two second-hand Diesel generator sets of 300 kW each and putting them down in a temporary power house. In consequence the section was in production by the desired date.

Having fixed the date of completion, a chart should be prepared on a large sheet of square paper marked out in days and months along the bottom, with the completion date near but not quite at the right-hand side. Leave a little room in case the original programme falls behind schedule owing to unavoidable delays.

Major items of the plant, equipment and buildings should then be entered one below the other down the left-hand side, and the dates for the various stages of progress with each must be fixed by working *backwards* from the date of completion, so that if the dates are kept everything will be finished at the same time. To do this correctly requires a good deal of experience and very careful working out of the time required for each stage, and, of course, the taking account of the degree of progress necessary in the buildings for erection of plant to be started, the date at which steam would be necessary to heat vessels and pipes for lagging, and many similar questions of interdependence between one item and another. By " stages " in this connection is meant preparation of drawings, manufacture of plant, erection, testing, and so on, and in the case of buildings, excavation, foundations, manufacture of steelwork, erection of steelwork, brickwork, roofs, floors, and so on. When finished, this time programme chart shows when orders must be placed and work started for all the big items.

(*To be continued.*)

Advances in Advertising

Banquet Echoes of the Convention Cruise

MINISTERS of Sweden, Denmark, Norway and Finland were among the distinguished company which assembled at Grosvenor House, London, on Wednesday evening for the annual dinner of the Advertising Association. Sir Ernest Benn, chairman of Benn Brothers, Ltd., proprietors of THE CHEMICAL AGE, and president of the Advertising Association, who presided, fulfilled his final duty in a most successful year of office, when he responded to the toast of the Association, proposed by Mr. Herbert Morrison, M.P., leader of the London County Council. Among those present were Lady Benn, Lord Leverhulme, Commander Ellis (Imperial Chemical Industries, Ltd.), Mr. and Mrs. R. R. Bennett (British Drug Houses, Ltd.), Mr. and Mrs. W. Lloyd Willey (Thomas Hill-Jones, Ltd.), and Sir Edward and Lady Crowe.

Mr. MORRISON, who prefaced his remarks by some amusing reference to several of the trade journals which Sir Ernest Benn controls, said truth in advertising should be like Cæsar's wife—attractive to look at but above suspicion. There were incalculable opportunities apart from commerce, for modern publicity rightly used. One could scarcely conceive the benefits that would result from campaigns on such subjects as the public services, world peace, health, education and, last but not least, London. It was being increasingly recognised that non-political publicity, properly organised and wisely handled, for the work of our national and local authorities was in the public interest. The moral level of advertising was steadily improving, and abuse in advertising had decreased. To this welcome development newspaper proprietors had contributed.

Sir ERNEST BENN, in the course of his reply to the toast, said Mr. Morrison had quite obviously missed his vocation. He was always amazed when he listened to pukka Socialists, and to see the practical salesmanship and wonderful advertising tendency which they developed. He visualised the Right Hon. gentleman as a salesman, spending five days a week abolishing a system, and two days, or two nights a week going and telling those about to be abolished how nice and jolly and happy everybody would be. If Mr. Morrison ever had time to read the newspapers, he was faced with the fact that the opposition shop had an imitation article which did the job better for half the money. Was there an advertising practitioner amongst them who could keep solvent with a proposition such as that?

It was agreed by all political parties that the one job above all others which required attention in the distressed world to-day was the job of rehabilitating overseas business. The Association decided that there had been enough talk about that matter, and that something really practical should be done. Therefore they set out on a tour of inspection of the Northern capitals with the results which were now known to most people They came upon a very vital and fundamental idea. It happened that the four countries visited represented Scandinavia, and it was some gratification to know that the idea which the Association started was taken up some three months later—he did not know whether it was by the Bank of England or the Government—but at any rate, as a result a new form of currency agreement was arrived at.

The toast of " The Chairman " was proposed by Sir JOSIAH STAMP, who said he believed in discrimination in the use of advertising. For instance, it was necessary for the railways to advertise.

During the evening, several films of the Convention Cruise were shown, including those taken by Mr. W. C. Thorn, Mr. K. Witherington, Sir Frederick Minter, Mr. C. W. Gardner, Mr. W. E. B. Lawrence, Mr. A. R. Jackson, Sir Robert Evans and Mr. E. G. Benn.

Modern "Bunsen Burners" for Laboratories

Improvements in Gas Equipment

GOOD equipment is essential to produce good results. Badly made apparatus tends to encourage slovenly work, and badly designed equipment is not only more difficult to keep adjusted, but much more expensive to run.

Even the simple Bunsen burner has been improved. One of the new types here illustrated from "A Thousand and One Uses for Gas" (No. 271) differs from the older type in being made to much finer limits. The jet is more accurately bored, the Venturi tube is carefully made to give the maximum possible aeration, a Méker grid is fitted to the top of the mixing tube and a variety of special heads is available giving differently shaped flames. These two pattern burners give a very high flame temperature and can be turned down very low without lighting back. This burner is typical of the care with which modern gas equipment is designed and made. Another good example is the glass-blowing burner illustrated. Here again by careful design and accurate workmanship a series of burners has been produced which will give any type of flame from the finest needle point to the large comparatively soft flame required for heating a large area evenly.

For special purposes and where speed of working is important, a number of specially designed Bunsen burners are available. For high temperature work and quick heating the Méker type of burner has considerable advantages, since it makes possible a more highly aerated and therefore smaller and hotter flame. It also has the advantage of allowing a bigger turn down range. There is, however, the disadvantage that the grid is liable to become choked with careless use.

A particularly well designed and well made burner of the Méker type is the burner illustrated in Figs. 1 and 4. Owing to its accurately made ejector and Venturi tube, a very high degree of aeration is obtained and a number of useful heads are available to give differently shaped flames. For quick heating, for glass bending where an air blast burner is not available, and in any laboratory where a pride is taken in the appearance of the equipment, this burner is very suitable. It

Fig. 1

Fig. 2

Fig. 3

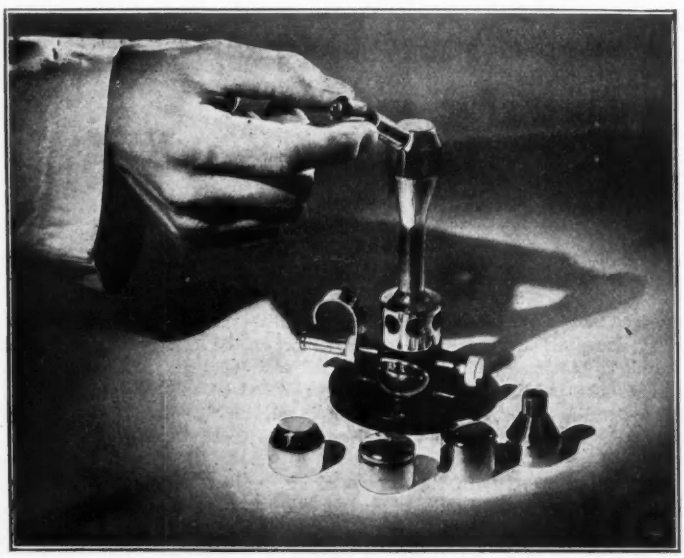


Fig. 4

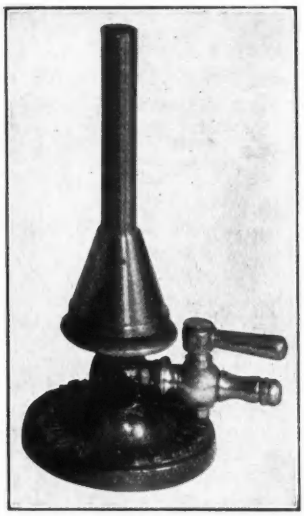


Fig. 5

should not be chosen, however, where a reducing flame may be required as it is not fitted with an air slide. A range of Méker type burners is illustrated in Fig. 7.

Where an air blast burner is required, but air under pressure is not available, there is available a burner (Fig. 10) which provides its own air blast by means of a vibrating diaphragm in the cylindrical base. The diaphragm is made of rubber, and is fitted with a steel disc which is in the field of a small electro-magnet. An alternating current from the mains is applied to the electro-magnet and this induces a vibratory movement of the diaphragm; by this means a stream of air is injected into the burner. The amount of air so injected may be varied by adjusting the distance between the diaphragm and the electro-magnet. The burner is capable of giving a fully aerated flame if required

A number of other special Bunsen burners are illustrated in Figs. 2, 5 and 6. A burner with a by-pass (Fig. 6) may sometimes be useful when it is required intermittently. In cases where a burner has to be thermostatically controlled it is often more satisfactory to use a flat-flame burner which cannot light back, rather than a Bunsen. Naturally flame contact with any part of the apparatus must be avoided in this case. Fig. 3 shows an adjustable micro-burner, which is very useful

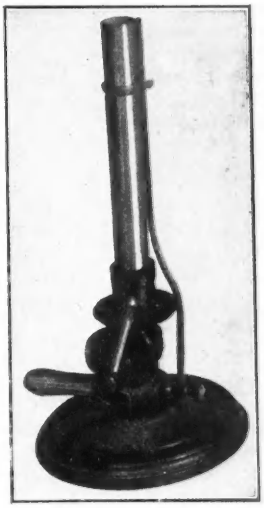


Fig. 6

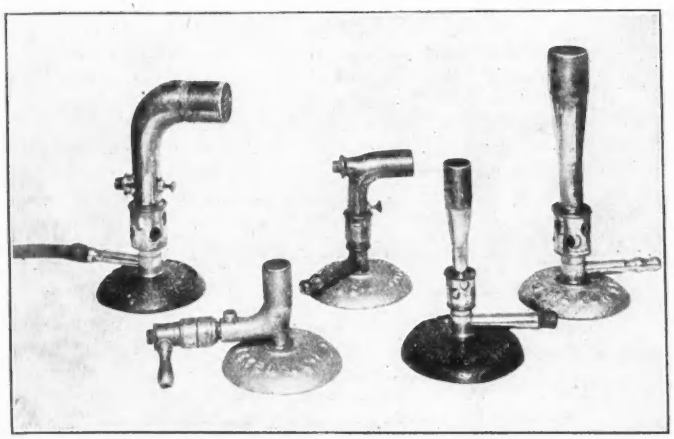


Fig. 7

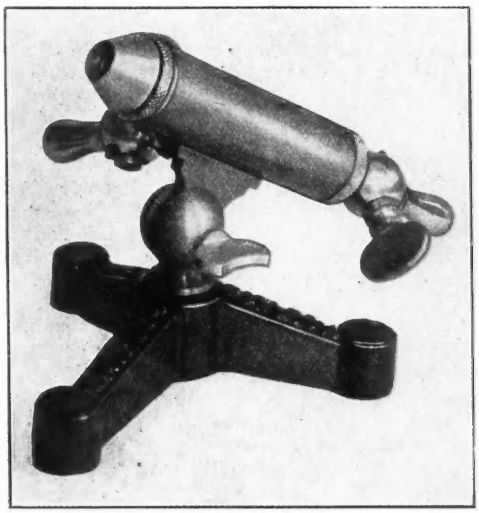


Fig. 8

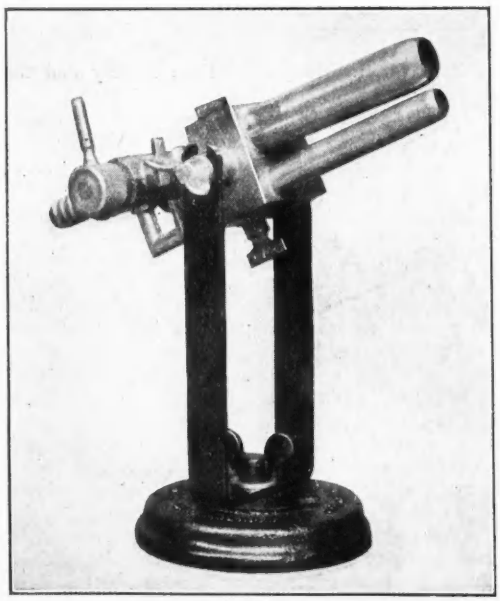


Fig. 9

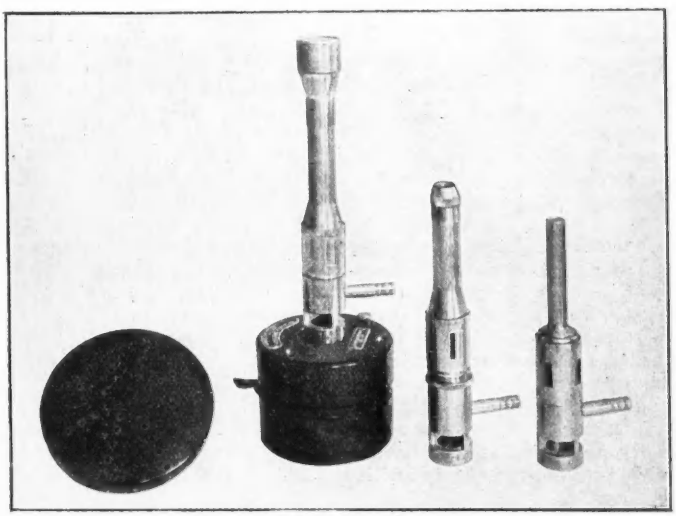


Fig. 10

for micro-analyses where only small quantities of the material to be analysed are available.

Except in metallurgical laboratories, the main uses for air blast burners are glass blowing and glass bending. The commonest and most adaptable type of glass blowing burner consists of an outer tube connected with the gas supply and an inner concentric tube connected to the air supply. The inner tube is a push fit into a gland at the back of the outer tube and any type of glass or metal jet can be easily fitted into the end of the inner tube. The gas need not be turned off while changing jets. A burner of this kind is shown in Fig. 8.

Another type of burner which gives very accurate flame-shapes and which is particularly useful for repetition work of any kind is that illustrated in Fig. 9.

Modern Dry Cleaning Soaps

Use of Triethanolamine and Related Synthetics

THE principles and practice of dry cleaning and laundering have, in common with many other industries both old and new, derived very considerable benefit from the great achievements of manufacturing chemistry in the past decade. Of prominent value and interest among these achievements has been the establishment of a long series of synthetic organic chemicals of the aliphatic class—mono- and dihydric alcohols, and their related esters, amines, ethers, acids, ketones, etc.—and certain of these products have proved of the most diverse, advantageous and, moreover, easy application in the science of dry cleaning and textile detergents.

As a preliminary step the products from this range which have especial value with reference to dry cleaning and associated products have been briefly enumerated in a booklet issued by General Chemical and Metallurgical, Ltd.

On mixing 140 parts triethanolamine with 282 parts oleic acid and stirring for a short time a soap, triethanolamine oleate, is formed by direct addition of the nitrogen atom *without liberation of water*. This soap is stable and a true organic soap freely soluble not only in water and alcohols, but in petroleum spirit, mineral oils and chlorinated solvents, without the customary and necessary considerable excess of free fatty acid in " benzine " soap.

Three Desiderata in Dry Cleaning Soap

Dry cleaning soaps may be prepared with triethanolamine as the base which exhibit the following conspicuous advantages: (1) They are freely soluble in dry cleaning spirit when from 80/100 per cent. saponified. This reduces to a minimum the retention of free fatty acid in the goods, and the disposition of such free acid to react with residual metals in textiles, such as those derived from tinweighting of silk, or mordanting of dyes, leaving rancid deposits conducive to residual odours. (2) A very liberal modicum of water may be blended into the soaps capable of stable incorporation into dry cleaning spirit. This is well known greatly to promote detergent action, and in combination with a relatively strong soap addition has been proved by ample experience to increase the thoroughness of cleaning and to effect a substantial reduction in the tedious and expensive process of " spotting " of residual stains. (3) They are exceptionally well suited for operation in high pressure filter systems of cleaning and recovery. Strong soap solutions in dry cleaning spirit may be prepared with relatively low viscosities, and with an indefinitely wide range of permissible dilution without separation. This maintains the filters without clogging and without the accumulation of undue pressure for long periods.

These three desiderata impart great value to triethanolamine in dry cleaning soaps apart from facilitating easy and excellent workmanship. It should be borne in mind that in matters of cost, triethanolamine conveys economies in reducing the extent and necessity of " spotting," which is the dry cleaner's heaviest process cost; and in the simplification and reduction of wear in filtering operations. As regards initial cost, it is important to note that triethanolamine is now being manufactured on a cheaper and more extensive scale than ever previously and is available at very materially lower prices.

Monoethanolamine is also capable of similar advantageous use in dry cleaning soaps, and, although slightly more expensive than triethanolamine, the lower combining weight ensures an aggregate saving. Another and still newer organic base which forms soaps freely soluble in oils is the di-acidic base ethylene diamine, which has the remarkably low combining weight of 30. Monoethanolamine and ethylene diamine are progressively stronger in alkalinity than triethanolamine.

By their strong surface tension depressant effect and their property of solubility in both water and oils the triethanolamine soaps have emulsifying and dispersing characteristics of a high order. In general, triethanolamine may be used with fatty acids to emulsify simply and effectively any oil, fat or wax or derived compositions. The strong emulsifying effect on mineral oils and greases finds effective application in carpet cleaning soaps and shampoos. The function here is not only one of thorough penetration, but also emulsification of residual mineral oils and greases deriving from the carpet manufacture.

Sturtevant Trade Name

Action Against a United States Company

IN the Chancery Division on October 16, Mr. Justice Farwell concluded the hearing of the action by the Sturtevant Engineering Co., Ltd., for an injunction restraining the Sturtevant Mill Co., U.S.A., Ltd., from commencing or carrying on business in this country under any title of which the "Sturtevant " formed part.

Mr. A. Grant, K.C., said the case for the plaintiffs was that they carried on an extensive general engineering business and particularly in the manufacture and sale of grinding and crushing mills, screens, separators, fans, heating and ventilating plant, electrical plant and equipment and workshop and factory plant. They advertised largely and the name of " Sturtevant " in the machinery trade meant the plaintiffs' company. The use of the name by the defendants they contended was calculated to deceive the engineering and trading public and do irreparable damage to the plaintiffs' business and their valuable goodwill. Under the circumstances the plaintiffs felt bound to bring their action to stop the use of their name by the defendants.

Mr. Roxburgh, K.C., for the defendants, said the defendant company had adopted their name expressly to distinguish it from the plaintiffs. They had no intention of using the name " Sturtevant " except in conjunction with the letters U.S.A. He therefore asked his lordship to dismiss the action.

His lordship, after hearing evidence, said he was satisfied on that evidence that the plaintiffs had, partly by expenditure in advertising and partly by the way they had carried on their trade, acquired a goodwill in the name " Sturtevant," and they were therefore entitled to have it protected. The plaintiffs had property which was capable of being injured and in his view the use of the name by the defendants would inevitably lead to damage to that property. There was here in his opinion a real risk and therefore he granted an injunction, with costs, restraining the defendants from using the name " Sturtevant " in their title.

Some Recent Technical Advances in Industry

Specialised Research in Detergents

THE opening meeting for the 1936-1937 Session of the Liverpool and North-Western Section of the Institute of Chemistry was held at the Constitutional Club, Liverpool, on October 15, when the new chairman, Mr. L. V. Cocks, F.I.C., gave an address on "Some Recent Technical Advances in Industry." Of the two types of advances which were selected to illustrate recent developments, the first was chosen to illustrate the developments which result from specialised research in connection with the detergent industry, and the second, which is of a more general character, to illustrate the great advantage which has been taken in recent years of applying fundamental scientific principles in the development of products and processes.

The historical development of non-soapy detergents, by which term it was not intended to include the large range of inorganic alkali salts which are used for detergent purposes, was described from the early use of Turkey Red oil, or sulphonated castor oil, through the period when trials were made with esters and amides of fatty acids, to the present-day so-called non-soapy detergents. These detergents are now represented by such bodies as the sulphates or sulphonates of fatty alcohols, by sulphonate and ester derivatives of ethylene glycol, or by the products of the partial esterification of polymerised glycerol with fatty acids. Solutions of these substances resemble solutions of soap in respect of many properties, such as surface tension, lathering and cleansing or detergent action. The special advantages of non-soapy detergent solutions are that they are practically unaffected by hardness or slight acidity in the water.

One of the first of these detergent products to appear on the market was a shampoo powder, the special properties of which in respect of imparting lustre and "life" to the hair have been readily appreciated by the public. Non-soapy products which have been specially prepared for laundries are on the market and are being employed with success in certain classes of high quality laundry work. Just recently a non-soapy washing preparation for domestic use has been prepared.

Wrapping and Packaging

The other examples of recent advances which were chosen by the speaker related to various aspects of wrapping and packaging, and to air conditioning, both of which subjects were of wide and general interest to industry. For wrapping and packaging the developments which have taken place in respect of the improvement in transparent regenerated cellulose films of the cellophane type, and in waxed papers, were described, together with the particular difficulties with which such developments have been accompanied.

The production of the moisture-proof film of transparent regenerated cellulose by the coating of each side of the film as produced from the viscose with an extremely thin layer of lacquer was described, and attention was directed to the necessity for the use of special printing processes and of modified adhesives for such materials. In order to obtain the necessary register for the automatic wrapping of materials with printed cellophane, use had been made of the selenium cell electric eye, the light from which was cut off by an opaque or metallic printed spot which accurately registered the correct position.

Reference was made to the improvements which had taken place in the production of tinplate and tinbox containers. By way of illustration of such improvements, sections of empty half-pint "cans" of beer were exhibited to show the methods of lacquering and waxing which were adopted to ensure that the beer was in perfect condition when it reached the consumer.

A description was also given of the equipment which was necessary for the conditioning of air at temperatures and humidities, which, on the one hand, were between the maximum and minimum limits of the normal atmosphere, and which on the other hand were above the maximum limit of the normal atmosphere in respect of temperature. Emphasis was directed to the greater ease with which the latter air conditions could be met, as advantage was taken of the ease with which air could be saturated by means of fine sprays of water at any particular temperatures, the excess water being removed by a system of baffling. With the correct adjustment of the temperature of the air at complete saturation point, it automatically followed that on raising the temperature of such air the desired relative humidity in the conditioned air was obtained.

Institute of Chemistry

September Examinations

THE Institute of Chemistry has issued its pass list for the September examinations as follows:

Examination in General Chemistry for the Associateship:—C. Bridges, College of Technology, Manchester; Municipal Technical College, Widnes; and City Technical College, Liverpool. H. Briggs, Technical College, Huddersfield. H. Dedicoat, City Technical College, Liverpool. E. L. Deeley, Royal Technical College, Glasgow. C. Harris, Merchant Venturers' Technical College, Bristol. W. Keane, City Technical College, Liverpool. G. A. Knight, University College, Nottingham. W. M. Lewis, City Technical College, Liverpool. G. S. Mills, Municipal Technical College, Blackburn. R. A. Reed, The Sir John Cass Technical Institute, London. J. G. Rimmer, City Technical College, Liverpool. J. M. Russell, Northern Polytechnic, London. G. F. Skelton, Municipal Technical College, Hull. S. W. Sleigh, Central Technical College, Birmingham. G. S. Towler, College of Technology, Leeds. J. N. Vickers, The Sir John Cass Technical Institute, and Chelsea Polytechnic, London. J. J. Wark, Royal Technical College, Glasgow. E. H. Watson, Chelsea Polytechnic, London.

Examinations for the Fellowship:—In Branch A: Inorganic Chemistry—G. Moses. In Branch C: Organic Chemistry, with special reference to Oils, Fats and Waxes—D. N. Grindley and G. Walley. In Branch E: The Chemistry, including Microscopy, of Food and Drugs, and of Water—W. R. Chanmugan, J. A. Macnair, R. H. McKinley and H. A. Parkes. In Branch G: Industrial Chemistry, with special reference to Oils and Fats and Soapmaking—H. Jasperson.

Irish Free State Chemical Industry

Census of Production Statistics

THE Census of Production for 1935 issued by the Irish Free State Department of Industry and Commerce shows that the gross output of fertilisers, chemicals, drugs, paints and polishes increased as compared with the previous year. The following table shows the quantities of some of the items produced in 1935, with their net selling value. The corresponding figures for 1934 are given in parentheses:—

Fertilisers: Superphosphates and compound manures, 103,479 tons (103,263), value £329,126 (£328,775); bone meal, 123 tons (111 tons), value £769 (£510); tankage, 479 tons (297), value £2,358 (£1,353); sulphuric acid, 2,425 tons (2,597), value £6,979 (£6,492); all other products, selling value £41,299 (£33,469).

Insecticides and Disinfectants: Disinfectants, weed-killers, insecticides and sheep and cattle dressings, net selling value £26,942 (£30,153); spraying materials and other chemicals, net selling value £21,031 (£16,262).

Personal Notes

MR. R. F. HUNTER, D.Sc., Ph.D. (London), has been appointed assistant lecturer in chemistry in the University of Manchester.

MR. FRANK MORTON and MR. L. W. DERRY, demonstrators in applied chemistry in the Faculty of Technology in the University of Manchester, have resigned.

MR. ARTHUR D. COLLINS has been presented with a walnut bureau by the staff and employees of the Globe Sugar Refinery, Greenock, on his retirement after over 30 years' service.

MR. JAMES T. FORGIE, who was a prominent figure in the Scottish iron and coal industries for half a century, died on Sunday morning at his residence, Well Hall, Hamilton. He was chairman of William Baird and Co., Ltd., coal and ironmasters, Glasgow, for many years, and also a director of the National Benzole Co. and the Sulphate of Ammonia Federation. He held many other appointments in Scotland. He was 81 years old, and is survived by his wife, two daughters and a son.

DR. WALTER S. LANDIS, vice-president of the American Cyanamid Co., New York, who has been awarded the Chemical Industry Medal of the Society of Chemical Industry, will receive the medal at a joint meeting of the American Section of the Society of Chemical Industry and the American Chemical Society at the Chemists' Club, New York, on November 6. Dr. Landis will present a paper on "Concentrated Fertilisers" and Dr. M. C. Whitaker will speak on the subject of the medallist. Dr. D. D. Jackson, of Columbia University, will make the presentation.

MR. W. S. LLOYD-WILLEY, of Thomas Hill-Jones, Ltd., who wrote to the King after the disturbances in the East End on October 4, asking him as chief of the country "to stop this nonsense of Sir Oswald Mosley," has received the following letter from the Under Secretary of State, Home Office: "Your letter of the 5th inst. addressed to His Majesty the King regarding the recent occurrences in the East End of London has, by His Majesty's command, been forwarded to the Secretary of State and I am directed by him to inform you that your representations will receive due consideration."

THE DUKE OF KENT has consented to grant his patronage to the congress of the International Association for Testing Materials, which is to be held in London on April 19-24, 1937.

MR. ROBERT T. R. ANDERSON, chemical manufacturer, 42 Roslea Drive, Dennistoun, Glasgow, left estate valued at £5,036.

DR. THOMAS MIDGLEY, junior, who has been elected to receive the Perkin Medal of the Society of Chemical Industry for 1937, will be presented with the medal at a meeting at the Chemists' Club, New York, on January 8.

MR. L. S. CLARKSON, of 92 Singleton Avenue, Prenton, Birkenhead, a student at Liverpool University, who obtained first-class honours in chemistry at the examination at the end of last session, has been awarded the Leverhulme Chemistry Prize awarded by the Society of Chemical Industry.

MR. WILLIAM GRAHAM, managing director of the Western Rubber Tyre Co., Port Dundas, Glasgow, was found dead in a railway carriage at Bedford last week. He resided at Regent Street, Kirkintilloch.

MR. WILLIAM R. GORDON, who has been manager of Bell's Dufftown-Glenlivet Distillery for three years, has been appointed manager of Inchgower Distillery, Buckie, on its purchase by Arthur Bell and Sons, Ltd., Porth. Mr. James McIntosh will be brewer-in-charge of Dufftown-Glenlivet.

MR. EDWARD ROBERTS has resigned from the managership of Deans Oil Works, West Lothian, after 50 years' service. The employees presented him with a dressing case, a tea trolley, and a gold wristlet watch for Mrs. Roberts. At a farewell dinner at Middleton the officials of Scottish Oils, Ltd., gave Mr. Roberts a set of gold studs and sleeve links and a wallet of treasury notes.

AT A MEETING of the board of the Institute of Physics on October 14 the following were elected to membership: Fellows—A. W. Lay, J. M. Rayner, W. B. Rimmer and R. Samuel; Associates—R. W. Crabtree, R. W. France, C. H. Garrett, J. I. Jones, T. Ling-Chao, J. H. Nelson, W. Singleton, C. I. Snow, F. J. Symon, I. H. Thomas, W. J. Thomas and R. F. Thyer; Students—M. S. S. Crosbie, K. N. Middleton and P. R. Stevens.

Chemical Notes from Foreign Sources

Roumania

SODIUM SULPHIDE is being made by the Phoenix Works, of Baia-Mare.

Portugal

THE MANUFACTURE OF SULPHUR FROM PYRITES is being carried out on an increasing scale in Portugal, according to the "Chemische Industrie."

Switzerland

PLANS HAVE BEEN WORKED OUT for establishing a wood saccharification factory with an input capacity of 24,000 cubic metres in the Canton of Grisons, with the financial assistance of the Central Cantonal Bank.

Russia

THE EXTENSIVE DEPOSITS OF LIGNITE in the Burjato-Mongolian Republic are to be subjected to exploitation in the near future within the scheme of the third five year plan. Among the projects contemplated are plants for subterranean gasification and for petrol and wax extraction and an electrical power station.

Poland

THE NITON COMPANY, of Krochmalna 87, Warsaw, has been formed, with a capital of 10,000 zloty, for production of pure and technical chemicals.

Norway

EXTENSIONS TO THE THAMSHARN WORKS of the Orkla Grater A.B. are expected to bring up the annual sulphur production to 150,000 tons in the coming year.

Hungary

SULPHOXYLATES have now been added to the range of manufactures of the Graf Ludwig Batthyany Chemische Fabrik A.-G., in Polgardi, which already makes sodium hydrosulphite.

Finland

FOLLOWING THE SATISFACTORY OUTCOME of this summer's preliminary borings by the Vuoksenniska O.Y. in the Pielisjarvi district and the location of extensive molybdenum ore veins by the Outokumpu O.Y. in the same area, actual mining operations are expected to commence in the near future.

From Week to Week

THE BRITISH GAS FEDERATION DINNER, which was to have taken place at Grosvenor House on November 2, under the presidency of Lord Dudley, has been postponed until next May.

THE ANNUAL DINNER of the Finsbury Technical College Old Students' Association will take place at the Trocadero on February 13. This is earlier than the usual date, and old students should book it up as soon as possible.

THE PROVISIONAL AGREEMENTS relating to the merger of Atlas Cement of South Africa, Ltd., with Anglovaal Portland Cement Co., Ltd., have now been signed, and the proposals await ratification by the stockholders and shareholders of the companies.

THE NEW DYE-WORKS AT WESTPORT, Irish Free State, which is being built in conjunction with the thread factory, is now almost finished, and the task of installing the necessary machinery is proceeding rapidly. It is expected that dyeing operations will be commenced next week.

THE EXECUTIVE COUNCIL OF THE IRISH FREE STATE has issued an Order relating to soaps, soap powders and soap substitutes, appointing the period from December 1, 1936, to May 31, 1937, as the Fourth Quota Period, and fixing the quota for that period at 1,600 cwts. of soaps, soap powders or soap substitutes of the description referred to in the 1935 Quota Order.

SIR ROBERT HADFIELD, who is a member of the advisory council of the Imperial Institute on Mineral Resources, has made a contribution of £1,000 to promote the compilation of mineral brochures by the Institute. In making this offer, Sir Robert emphasised the importance of iron and ferro-alloy metals to the Empire, and expressed a hope that this importance would be recognised in the brochure programme of the Institute.

THE ANNOUNCEMENT of an entirely new road material, the result of long co-operation with the Ministry of Agriculture and Fisheries and the Government Chemist's Department, will be made at the annual meeting of the British Road Tar Association in London, on November 5. The meeting, the ninth of the series, will be presided over by Sir David Milne-Watson. Sir Reginald Clarry, M.P., chairman of the Constructional Section of the Parliamentary Road Group, is chairman of the Association.

"SYNTHETIC MATERIALS" is the name of a novel show arranged under the auspices of the Dechema Deutsche Gesellschaft für chemisches Apparatewesen E.V., Berlin, W.35. This show is being held at Frankfort-on-the-Main on the occasion of the National Congress of German Chemists. The field which will be comprehensively covered by this show includes the production, processing, machining, application and science of synthetic materials, particularly such recently developed materials as synthetic resin plastics and synthetic rubber.

A PUBLIC LECTURE has been arranged by the Institution of Chemical Engineers on "Research at the Lowest Temperatures and its Importance to Industry," which will be delivered by Professor F. A. Lindemann, of Oxford, on October 30, at the Institution of Civil Engineers, Westminster, at 6.30 p.m. Professor Lindemann proposes to show how investigations of this type are of the highest importance to the chemical industry; for instance, the calculation of the best temperatures and pressures for the production of synthetic ammonia depends on work very near the absolute zero.

A BY-PRODUCT MADE FROM WASTE LIQUIDS of the chemical process of paper making is being used successfully, instead of the usual road oil, in the state of Washington. It is much less expensive and makes an excellent road-binder. For years this liquid waste was poured into the bay until the paper company became involved in suits with the owners of oyster beds. An expensive pipe-line was then constructed and the waste allowed to evaporate in a large artificial lake in the hills. Maintenance, however, was too expensive, and the final solution to the problem was found by the research department of the Rainier Pulp and Paper Co., of Shelton, Washington, when the by-product, known as Raylig, was produced.

THE LAUTARO NITRATE CO., LTD., informs holders of first mortgage 6 per cent. convertible gold dollar bonds that the scheme of arrangement for the readjustment of the capital structure of the company was approved at the meetings held in New York and London on September 24 last. Application for the sanctioning of the scheme will be made to the High Court in England during the course of the present month. Holders are reminded that, in order to facilitate the issue of the new securities contemplated by the scheme, those who have not already deposited their bonds are urged, in their own interests, to do so promptly. The time for the deposit of bonds has been extended to October 31, 1936. Copies of the scheme of arrangement, together with letters of transmittal, to accompany the deposit of bonds which must be sent to the Bankers Trust Company, Corporate Trust Department, 16 Wall Street, New York, may be obtained from the Lautaro Nitrate Co., Ltd., Friars House, New Broad Street, London, E.C.2.

THE INTERNATIONAL TIN RESEARCH AND DEVELOPMENT COUNCIL has made a grant to aid research in the metallurgical department at Manchester University.

ROBINSON BROTHERS, LTD., manufacturers of rubber accelerators and other chemicals at West Bromwich, are moving their head office from Exchange Buildings, Birmingham, to Oldbury. From November 2 the address of the head office will be Oldbury, Birmingham. (Telephone: Broadwell 1661.)

CEFOIL, LTD., of Bellochantuy, Campbelltown, concluded negotiations on October 15 for the renting and occupying of what was formerly a shipyard at Ness, Stromness, Orkney, along with the buildings and adjoining pier, for the purpose of carrying on the treatment of seaweed for the manufacture of various products.

IN THE CHANCERY DIVISION on October 16, Mr. Justice Bennett appointed Mr. John Ivan Spens, of Brown, Fleming and Murray, chartered accountants, to be receiver and manager of the Ebbw Vale Steel Iron and Coal Co., Ltd. His lordship gave Mr. Spens leave to borrow £5,000 immediately and to apply in chambers with respect to further sums required.

MIDLAND TAR DISTILLERS, LTD., of Exchange Buildings, Birmingham, have erected new offices on modern lines adjoining their principal works at Oldbury. From November 2, the address of the head office will be Oldbury, Birmingham. (Telephone: Broadwell 1661.) This change is part of a programme of centralisation which includes considerable alterations and extensions to plant at the works.

AT THE 21ST ANNIVERSARY LUNCHEON of the Glass Research Delegacy of Sheffield University, held in Sheffield, it was decided to go on at once with the first part of the scheme for converting a large private house in Northumberland Road, Sheffield, into new accommodation for the Department of Glass Technology at the University. The sum of £20,000 was asked for to equip the house with laboratories for high-temperature physics research, testing, thermal research, and optical research, and a large conference-room. At the luncheon it was announced that donations totalling £19,000 have been promised or received.

THE OPENING MEETING of the session of the Institution of Civil Engineers takes place on November 3, when Sir Alexander Gibb delivers his presidential address. At a special joint meeting on October 28, with the British section of the Société des Ingénieurs Civils de France, M. J. Greber will present a paper on "A Study of the System of Underground Road-Crossings in Paris." Major Cook, of the Ministry of Transport, will deal with road design and road safety in a paper on November 10, whilst at an informal meeting the subject of "Methods of Providing Permanent Non-Slip Surfaces for Roads" is to be discussed.

THE CENTRAL OFFICE of the World Power Conference announces that it will publish on October 28 the first number of the "Statistical Year Book of the World Power Conference." This volume will contain an inventory, based upon the latest available estimates, of the power resources of the world, and annual statistics, relating to 1935 and 1934, of the production, stocks, imports, exports, and consumption of solid and liquid fuels, natural gas, water power, and electricity. Statistics for about 60 countries will be included, and where practicable, continental and world totals will be presented. The tables will be accompanied by explanatory text. The statistics have been compiled according to standard definitions which are reproduced in the text, and it is believed that the volume will constitute the most comprehensive collection of closely defined and comparable statistics of power resources, development and utilisation yet published. The price will be £1.

THE SHIPMENTS OF CHINA CLAY made in September were very gratifying with an upward trend of nearly 10,000 tons increase compared with September, 1935. There was very little difference between the shipments of china stone in September, 1936, and September, 1935, whereas there were a thousand tons less of ball clay shipped in September this year than in the corresponding period in 1935. Details are as follows:—Fowey, 42,447 tone china clay; 1,796 tons china stone; 2,281 tons ball clay. Par, 10,704 tons china clay; 464 tons china stone. Charlestown, 5,293 tons china clay; 1,103 tons china stone; Padstow, 185 tons china clay. Newham, 211 tons china clay. Plymouth, 103 tons china clay. By rail, 5,549 tons china clay, making a total of 64,492 tons of china clay; 3,363 tons of china stone; 2,281 tons of ball clay for the month. For the nine months of the present year the volume of china clay despatched was within a few tons of 560,000 tons; when compared with a similar period in 1932 show an advance of nearly 142,000 tons, which is a remarkable recovery. China stone, though St. Austell has the monopoly of this production, does not seem to be recovering trade at the same ratio as china clay. Shipments up to September of the present year are 34,297, against 30,075 for the first nine months in 1935. The home markets, however, are beginning to get active in view of the making of Coronation mugs which should give an impetus to the production of china clay, china stone and ball clay.

Inventions in the Chemical Industry

THE following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Specifications Open to Public Inspection

ARSENOBENZENE-MONOSULPHOXYLATES.—I. G. Farbenindustrie. April 10, 1935. 2055/36.

COMPOSITE TITANIUM PIGMENTS and methods of making the same. United Color and Pigment Co., Inc. April 10, 1935. 2525/36.

PROCESS FOR THE PREPARATION IN A WATER-SOLUBLE AND ATOXIC FORM of inorganic compounds of heavy metals.—J. B. Deulofeu. April 6, 1935. 4002/36.

PIGMENTS.—New Jersey Zinc Co. April 6, 1935. 5377/36.

INSULIN PREPARATIONS.—H. C. Hagedorn, B. N. Jensen and I. Wodstrup-Nielsen. April 8, 1935. 6066/36.

PRODUCTION OF MALEIC ACID.—Carbide and Carbon Chemicals Corporation. April 9, 1935. 6914/36.

PREPARING ALDEHYDES.—Armour and Co. April 11, 1935. 7463/36.

PRODUCTION OF PHOSPHORIC ACID.—Aktiebolaget Kemiska Patenter. April 9, 1935. 8284/36.

METHOD OF CONDUCTING REACTIONS at high temperatures.—Ruhrchemie, A.-G. April 11, 1935. 8381/36.

MANUFACTURE OF VALUABLE PRODUCTS.—Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. April 11, 1935. 9430/36.

MAKING ALKALI SUB-SILICATES.—Pennsylvania Salt Manufacturing Co. April 10, 1935. 9492/36.

METHOD AND APPARATUS FOR DE-OILING THE NEUTRALISED SOAP STOCK from seed oils.—Aktiebolaget Separator. April 9, 1935. 10086/36.

RUST PROTECTIVE DYE.—W. E. A. Simon. April 6, 1935. 10091/36.

MANUFACTURE OF ORGANIC CHLORINE and bromine derivatives.—C. Hunsdiecker, H. Hunsdiecker, and E. Vogt. April 8, 1935. 10161/36.

PREPARATION OF A NEW ERGOT ALKALOID and its salts.—Chemical Works formerly Sandoz. April 11, 1935. 10360/36.

ANTI-FREEZE LIQUIDS FOR HEAT-EXCHANGERS and the like.—E. I. du Pont de Nemours and Co. April 11, 1935. 10395/36.

MERCERISATION OF VEGETABLE FIBRES.—I. G. Farbenindustrie. April 11, 1935. 10399/36.

INHIBITION OF CORROSION OF METALS.—E. I. du Pont de Nemours and Co. April 12, 1935. 10590/36.

WET TREATMENT OF FIBROUS MATERIALS.—I. G. Farbenindustrie. April 10, 1935. 10724/36.

MANUFACTURE OF POLISHES, shoe creams and other surface-preserving or dressing-agents.—Deutsche Hydrierwerke, A.-G. April 12, 1935. 10740/36.

LACQUERS.—Roxalin Flexible Lacquer Co. Nov. 21, 1934. 27198/36.

MAKING ZINC TUNGSTATE particularly for use in fluorescent screens.—Farnsworth Television, Inc. March 13, 1935. 27425/36.

Specifications Accepted with Date of Application

MANUFACTURE OF THREADS, FABRICS, and the like of cellulose or cellulose hydrate.—W. W. Groves (I. G. Farbenindustrie.) Feb. 1, 1935. 454,657.

ACYL COMPOUNDS OF POLYCYCLIC ALCOHOLS of the cyclopentano polyhydrophenanthrene series.—W. P. Williams (Schering-Kahlbaum, A.-G.) March 4, 1935. 454,790.

IMPROVING THE PROPERTIES OF PHTHALOCYANINE DYESTUFFS.—Coutts and Co., and F. Johnson (Legal representatives of J. Y. Johnson (deceased)). (I. G. Farbenindustrie.) April 5, 1935. 454,858.

ACYLATED POLYALKYLENE POLYAMINES.—I. G. Farbenindustrie. April 7, 1934. 454,723.

TREATMENT OF VEGETABLE OR ARTIFICIAL FIBROUS MATERIAL.—I. G. Farbenindustrie. April 7, 1934. 454,868.

DYEING AND PRINTING OF TEXTILE MATERIALS and dye preparations therefor.—E. I. du Pont de Nemours and Co. April 6, 1934. 454,869.

METHOD OF CONVERTING METALLIC ALUMINIUM with hydrogen chloride.—Ruhrchemie, A.-G. April 24, 1934. 454,939.

TEXTILE AND OTHER MATERIALS of organic derivatives of cellulose and processes for their production.—H. Dreyfus. April 9, 1935. 454,942.

INCREASING YIELD IN THE CATALYTIC SYNTHESIS of aliphatic hydrocarbons.—Studien-und Verwertungsges. April 25, 1934. 454,948.

MANUFACTURE OF CONDENSATION PRODUCTS.—W. J. Tennant (Henkel and Cie, Ges.). April 10, 1935. 455,008.

PRESERVATION OF RUBBER.—Imperial Chemical Industries, Ltd., W. Baird, and M. Jones. April 10, 1935. (Addition to 434,951.) 454,958.

TREATMENT OF VEGETABLE or artificial fibres.—I. G. Farbenindustrie. April 11, 1934. 454,875.

MANUFACTURE OF ACID DYESTUFFS of the anthraquinone series.—I. G. Farbenindustrie. April 11, 1934. 454,959.

MANUFACTURE OF GLUES, PASTES, and the like adhesives.—E. I. du Pont de Nemours and Co. April 11, 1934. 454,963.

MANUFACTURE OF COSMETIC PREPARATIONS.—W. W. Groves (I. G. Farbenindustrie.) April 21, 1934. 454,970.

MANUFACTURE OF ESTERS of phosphoric acids.—Celluloid Corporation. April 13, 1934. 455,014.

LIGHT-SENSITIVE DIAZO-TYPE LAYERS.—J. Halden and Co., Ltd., and J. Holden. April 30, 1935. 454,665.

MANUFACTURE OF AMINO-SULPHONES.—Coutts and Co., and F. Johnson (Legal representatives of J. Y. Johnson (deceased)). (I. G. Farbenindustrie.) May 10, 1935. 454,728.

MANUFACTURE OF MERCAPTANS of high molecular weight.—Coutts and Co., and F. Johnson (Legal representatives of J. Y. Johnson (deceased)). May 16, 1935. 454,668.

MANUFACTURE OF VAT DYESTUFFS.—Coutts and Co., and F. Johnson (Legal representatives of J. Y. Johnson (deceased)). (I. G. Farbenindustrie.) June 11, 1935. 454,882.

MANUFACTURE OF ORGANIC SULPHUR COMPOUNDS.—Coutts and Co., and F. Johnson (Legal representatives of J. Y. Johnson (deceased)). (I. G. Farbenindustrie.) June 12, 1935. 454,675.

ENCLOSURES FOR CHEMICAL TREATMENTS in the gaseous phase by catalysis.—Soc. Française de Catalyse Generalisée. June 25, 1934. 454,806.

DERIVATIVES OF PYRIDINE and quinoline.—Kodak, Ltd. Aug. 9, 1934. 454,687.

Applications for Patents

(October 8 to 14 inclusive.)

STABILISATION OF CELLULOSE ESTERS.—Afag Finnanzierungs, A.-G. (France, Oct. 9, '35.) 27426.

PRODUCTION OF CELLULOSE ESTERS.—Afag Finnanzierungs, A.-G. (France, Oct. 10, '35.) 27690.

MANUFACTURE OF AZO-DYESTUFFS of the anthraquinone series.—A. Carpmael (I. G. Farbenindustrie.) 27565.

PRODUCTION OF ANHYDROUS BORAX.—Chemische Fabrik Grünau Landshoff and Meyer, A.-G. (Germany, Dec. 7, '35.) 27757.

MANUFACTURE, ETC., OF CATALYSTS for hydrogenation, etc., processes.—F. H. Durrans, and B. T. D. Sully. 27366.

METHOD OF MAKING ZINC TUNGSTATE.—Farnsworth Television, Inc. (March 2.) (United States, March 13, '35.) 27425.

PRODUCTION OF SUGAR, ETC.—L. C. A. Feurtado. 27909.

RECOVERY OF METALS FROM SOLUTIONS.—E. L. Francis (Tube Gold Extractors (Proprietary)), Ltd. 27704.

MANUFACTURE OF VISCOSE RAYON.—Imperial Chemical Industries, Ltd., and J. G. Evans. (Oct. 9, '35.) 27499.

MANUFACTURE OF ISOCYANATES.—Imperial Chemical Industries, Ltd., R. Greenhalgh, and H. A. Piggott. 27943.

INSECTICIDES.—J. A. Jago. 27552.

PRODUCTION OF ARTIFICIAL SUBSTANCES.—G. W. Johnson (I. G. Farbenindustrie). 27353.

PRODUCTION OF ETHYL CHLORIDE.—G. W. Johnson (I. G. Farbenindustrie.) 27354.

MANUFACTURE, ETC., OF HYPOSULPHITES.—G. W. Johnson (I. G. Farbenindustrie.) 27636.

PRODUCTION OF COMPOUNDS OF 4.5.9.10-DIBENZO-3.8-PYRENEQUINONE SERIES.—G. W. Johnson (I. G. Farbenindustrie.) 27906.

PRODUCTION OF VAT DYESTUFFS OF 4.5.9.10-DIBENZOPYRENE-3.8-QUINONE SERIES.—G. W. Johnson (I. G. Farbenindustrie.) 27907.

PRODUCTION OF WATER-INSOLUBLE ARTIFICIAL MATERIALS.—G. W. Johnson (I. G. Farbenindustrie.) 27908.

PRODUCTION OF ANTHRAQUINONE COMPOUNDS.—G. Lord and G. Reeves. 27905.

CONVERSION OF HYDROCARBON OILS.—A. L. Mond (Universal Oil Products Co.). 27786.

PREPARATION OF ALKALINE SILICATE.—Montecatini Soc. Generale per l'Industria Mineraria and Agricola. (Italy, Oct. 12, '35.) 27637.

PREPARATION OF ALKALINE SILICATE.—Montecatini Soc. Generale per l'Industria Mineraria and Agricola. (Italy, Feb. 1.) 27638.

ORGANIC COMPOUNDS.—W. H. Moss. 26740.

PROCESSES FOR COMBINING ORGANIC GROUPS.—Naamlooze Vennootschap Chemische Fabriek Servo, and M. D. Rozenbrock. 27946.

MANUFACTURE OF AMMONIUM PHOSPHATE.—D. V. Plumbridge. 27844.

PROCESS FOR DETERMINING EXCESS AMOUNT OF OXIDISING AGENT in purified water.—A. Schnorf. (France, Oct. 9, '35.) 27448.

PROCESS FOR DETERMINING EXCESS AMOUNT OF OXIDISING AGENT in purified water.—A. Schnorf. (France, May 27.) (Cognate with 27448.) 27449.

MANUFACTURE OF AZO-DYESTUFFS.—Soc. of Chemical Industry in Basle. (Switzerland, Oct. 23, '35.) 27773.

MANUFACTURE OF PRODUCTS CONTAINING CALCIUM NITRATE and ammonium nitrate.—Stockholms Superfosfat Fabriks Aktiebolag. (Sweden, Nov. 13, '35.) 27869.

Chemical and Allied Stocks and Shares

SINCE the beginning of the new Stock Exchange account on Monday the tendency has been for activity in the industrial and other sections of the Stock Exchange to increase. B. Laporte were more active around 126s. 3d. in response to the belief that either a favourable increase in dividend or a bonus of some kind is in prospect. Imperial Chemical at 41s. 10½d. have lost a moderate part of their recent advance. In view of indications that it is the intention to add large sums to reserves, it is not expected the dividend will be increased, but the yield offered on the basis of last year's 8 per cent. dividend is rather larger than that on many other leading industrial shares. Fison, Packard were lowered to around 45s. on the repetition of the dividend at 9 per cent. as a moderate increase to 10 per cent. had been hoped for in the market, but profits have increased favourably and the dividend in payable on a larger capital. Imperial Smelting responded to the rise in the price of zinc and have now regained the 17s. level which ruled recently.

Cooper, McDougall and Robertson were more active and higher at around 37s., it being realised that recovery in the Argentine and other agricultural countries should lead to a much better demand for the company's cattle disinfectants and other products. Borax Consolidated at 35s. have lost part of their recent rally, but the general impression in the market is that there appears to be reasonable grounds for expecting a larger dividend. Distillers remained prominent and have made the higher price of 111s. 6d. there being reports of increasing sales of the company's petrol-alcohol motor spirit which is marketed by the Petroleum Storage and Finance Co. The market expects that before long the remaining arrears of dividend on the ordinary shares of the last-named company will be paid and that there are good possibilities of dividends being resumed on the deferred shares for the current year. The nominal value of the latter is 1s. and the current market price is 18s. 3d., due to the fact that the deferred shares represent only a moderate proportion of the total capital and that in a really good year earnings on them would consequently be at a high level. Turner and Newall at 102s. 7½d. have retained nearly all their recent further rise.

Goodlass Wall and Lead Industries were well maintained at 14s. 7½d. aided by continued anticipations that the company is likely to benefit from the higher price of lead and that prospects of an increase in dividend to 7½ per cent. are probably improved. It is assumed that in recent years the company has written down its lead stocks considerably, but that in view of the rise in the price of the metal no writing down of stocks is likely in future, in which case net profits would be expected to benefit. Pinchin Johnson rose sharply on the belief that a bonus may not be far distant. It may be recalled that it was stated at the last meeting that the company has reserves and undivided profits in excess of the requirements of the business. Other paint shares also received more attention notably Lewis Berger which benefited from hopes that the dividend may be raised to 17½ per cent. Greef-Chemicals Holdings 5s. ordinary shares have continued active around 9s. 3d. and the 5½ per cent. 10s. preference were firm at 12s. In view of the good earning capacity of the operating company as disclosed by the prospectus which was published earlier in the year, the market is taking a very favourable view of the dividend outlook of the holding company.

Borman Long preferred ordinary and ordinary shares were active on dividend possibilities. After the preference dividend the preferred ordinary rank for 8 per cent. and then equally for dividend with the ordinary up to a further 24 per cent. Consett Iron were again favoured and have moved up further to 17s. 6d. Associated Portland Cement reacted moderately. British Plaster Board were fairly steady, awaiting declaration of the interim dividend. Wall Paper deferred were again steady at 50s. pending confirmation of market hopes that the dividend will be maintained at 12½ per cent.

Oil shares were particularly active, especially "Shell" and Anglo-Iranian, the last-named on growing anticipations that the interim dividend may be raised from 5 per cent. to 7 per cent. Trinidad Leaseholds responded to the favourable impression created by the statements at the annual meeting.

Weekly Prices of British Chemical Products

WITH the exceptions quoted below the prices of British chemical products remain as reported in THE CHEMICAL AGE last week (pages 340-341.)

MANCHESTER.—Moderately active trading conditions have been reported during the past week on the Manchester market for chemical products. For the most part, new transactions in the heavy materials relate to deliveries over the next few weeks, although one or two fair-sized contracts have been placed. A satisfactory feature is that the movement of supplies into consumption keeps up, and in this connection the improvement in the cotton textile trade of the district compared with what it was about twelve months ago is reacting favourably upon the demand for a wide range of chemicals for use in the dyeing and finishing branches. Prices generally are steady and in a number of directions the undertone is firm. In the market for by-products pitch continues rather quiet, but in other respects a fair trade is passing.

GLASGOW.—Business in general chemicals has been rather quiet during the week, both for home trade and export. Lead and copper products remain very firm in sympathy with the metals. Business in coal tar by-products has been steady. Prices generally are maintained at about previous figures, with no important changes to report. The prevailing high value of cresylic acid is tending to make buyers less anxious to purchase beyond their more pressing requirements, but there is still no evidence of any price slackening. Fair quantities of solvent and heavy naphthas have been moving both for home and export. The lighter fractions of pyridine are in demand greater than the supply, while the heavy grades are rather slow to move. Pitch continues to resist the prices offered for export.

General Chemicals

ARSENIC.—LONDON.—£13 10s. per ton c.i.f. main U.K. ports for imported material; Cornish nominal, £22 10s. f.o.r. mines. SCOTLAND: White powdered, £17 10s. ex store. MANCHESTER: White powdered Cornish £18 10s. ex store.

LEAD ACETATE.—LONDON: White, £33 15s. per ton; brown, £1 per ton less. SCOTLAND: White crystals, £34 to £35; brown, £1 per ton less. MANCHESTER: White, £35, brown, £34.

POTASH, CAUSTIC.—LONDON: £42 per ton. MANCHESTER: £40.

POTASSIUM CHLORATE.—LONDON: £37 to £40 per ton. SCOTLAND: 4¼d. per lb. MANCHESTER: £38 10s. per ton.

SODA ASH.—58% spot, £5 12s. 6d. per ton f.o.r. in bags.

Coal Tar Products

ACID, CARBOLIC.—Crystals, 6¾d. to 7¼d. per lb.; crude, 60's, 2s. 5d. to 2s. 6d. per gal. MANCHESTER: Crystals, 6¾d. per lb.; crude, 2s. 8d. per gal. GLASGOW: Crude, 60's, 2s. 6d. to 2s. 9d. per gal.; distilled, 60's, 2s. 9d. to 3s. 3d.

CREOSOTE.—B.S.I. Specification standard, 5¼d. per gal. f.o.r. Home, 3¾d. d/d. LONDON: 4¼d. f.o.r. North; 5d. London. MANCHESTER: 4¾d. to 5¼d. GLASGOW: B.S.I. Specification, 5d. to 5¼d. per gal.; washed oil, 4¼d. to 4¾d.; lower sp. gr. oils, 4¾d. to 5d.

Latest Oil Prices

LONDON, Oct. 21.—LINSEED OIL was firmer. Spot, £27 (small quantities); Nov. and Nov.-Dec., £24 10s.; Jan.-April, £24 12s. 6d.; May-Aug., £24 15s., naked. RAPE OIL was quiet. Crude, extracted, £33 10s.; technical refined, £34 10s., naked, ex wharf. COTTON OIL was quiet. Egyptian crude, £26 10s.; refined common edible, £29 10s.; deodorised, £31 10s., naked (small lots 30s. extra). TURPENTINE was steady. American, spot, 38s. per cwt.

HULL.—LINSEED OIL, spot, quoted £24 10s. per ton; Oct., £24 5s.; Nov.-Dec., £24 7s. 6d.; Jan.-April, £24 10s.; May-Aug., £24 12s. 6d. COTTON OIL, Egyptian, crude, spot, £26 10s.; edible, refined, spot, £29; technical, spot, £29; deodorised, £31, naked. PALM KERNEL OIL, crude, f.m.q., spot, £25 10s., naked. GROUNDNUT OIL, extracted, spot, £34; deodorised, £37. RAPE OIL, extracted, spot, £33; refined, £34. SOYA OIL, extracted, spot, £29 10s.; deodorised, £32 10s. per ton. COD OIL, f.o.r. or f.a.s., 25s. per cwt. in barrels. CASTOR OIL, pharmaceutical, 43s. per cwt.; firsts, 38s.; seconds, 36s. TURPENTINE, American, spot, 41s. per cwt.

Company News

Kiesselbach Steam Accumulators.—The report for the year to April 30 last shows a surplus of £475; this reduces the balance debit of development and profit and loss account to £44,873. A certain amount of business, though not large, is now being carried out under agreement with Ruths Arca Accumulators, Ltd., and the directors are pressing this business forward as much as possible. Meeting, Bush House, W.C.2, October 26, at 12.30 p.m.

British Alkaloids.—An interim of 9 per cent., less tax, on ordinary shares and 6 per cent., less tax, on participating preference shares for the year to March 31, 1937, have been declared. Last year a first and final of 10 per cent. was paid.

English Clays, Lovering, Pochin.—Final dividends have been declared for the half year to September 30 in respect of 5½ per cent. first preference and 7 per cent. second preference shares. Warrants will be posted on October 31.

Fison, Packard and Prentice.—The accounts for the year ended June 30, show a trading profit of £142,253, compared with £123,073 for 1934-35. The net profit, after charging debenture interest and sinking fund, directors' fees, contributions to pension funds and income-tax, and providing £19,044 (against £15,719) for depreciation, amounts to £78,194—an increase of £6,443. The transfer to general reserve is £12,500, against £18,600, raising this fund to £287,500. A final dividend of 6½ per cent. is proposed on the ordinary shares, making 9 per cent. for the year, the same as for 1934-35, but on an increased capital, leaving £25,497 to go forward, compared with £20,117 brought in. The company carries on business as manufacturers of chemicals and fertilisers, and has an authorised capital of £1,000,000, of which £931,220 is issued in £242,360 7 per cent. preference shares and £688,860 ordinary shares of £1 each. Meeting, Ipswich, October 30, at 12 noon.

Chemical Trade Inquiries

The following trade inquiries are abstracted from the "Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

Finland.—A firm in Helsingfors wish to establish contact with United Kingdom manufacturer of casein, sulphate of alumina, chemicals, and other raw materials for the paper, pulp, and plywood industries. (Ref. No. 355.)

Finland.—A firm in Helsingfors wish to secure the agency of a United Kingdom supplier of china clay for the paper industry. (Ref. No. 356.)

Finland.—A firm in Helsingfors wish to undertake the agency, on a commission basis, of a United Kingdom manufacturer of paints for hot water tanks. (Ref. No. 358.)

Finland.—A firm in Helsingfors wish to secure the representation of United Kingdom manufacturers of aluminium in bars, rods and tubes, machinery and raw materials for wood pulp and paper-making industry. (Ref. No. 362.)

British India.—The British Trade Commissioner at Calcutta reports that the Indian Stores Department is calling for tenders (Order No. M-8570) for the supply and delivery on a rate contract basis during the period March 1, 1937, to February 28, 1938, of quantities of paints and dry colours: enamels; varnishes; and red oxide paints for wagon painting. Tenders should be addressed to the Chief Controller of Stores, Indian Stores Department (Miscellaneous Branch), New Delhi, by whom they will be received up to November 5, 1936. (Ref. T.28.)

New Chemical Trade Marks

Compiled from official sources by Gee and Co., patent and trade mark agents, Staple House, 51 and 52 Chancery Lane, London, W.C.2.

Membranol. 564,798. Chemical substances for use in the manufacture of varnishes and lacquers. I. G. Farbenindustrie, Grüneburgplatz, Frankfort-on-Main, Germany. December 2, 1935. Address for Service in the United Kingdom is, c/o Carpmaels & Ransford, 24 Southampton Buildings, Chancery Lane, London, W.C.2.

Lorival. 565,251. Synthetic resins in liquid and powder form, being chemical substances for use as ingredients in manufactures. Lorival Manufacturing Co. (1921) Ltd., Norwood Works, Norwood Green, Southall, Middlesex. December 20, 1935.

Alcosco. 565,244. Raw, or partly prepared, vegetable, animal, and mineral substances used in manufactures, not included in other classes, but not including coal and not including any goods of a like kind to coal. Commercial Solvents (Great Britain) Ltd., Aldwych House, Aldwych, London, W.C.2. December 19, 1935.

Cereclor. 560,445. Raw, or partly prepared, vegetable, animal and mineral substances used in manufactures, not included in other Classes. Imperial Chemical Industries, Ltd., Imperial Chemical House, Millbank, London, S.W.1. May 24, 1935.

Sanizal. 565,432. Raw, or partly prepared, vegetable, animal and mineral substances used in manufactures, not included in other Classes. Newton, Chambers & Co., Ltd. ,Thorncliffe Ironworks and Collieries, near Sheffield. December 31, 1935.

Nichrotan. 565,117. Raw or partly prepared mineral substances (not being dyes) for tanning. Fini Georges Alexander Enna, trading as F. G. A. Enna, 16 Camden Gardens, Sutton, Surrey. December 13, 1935.

Celite. 539,994. Diatomaceous silica for use in the filtering, dehydrating, and de-emulsifying of liquids. Johns-Manville Products Corporation, 292 Madison Avenue, New York, United States of America; manufacturers. March 17, 1933. Address for service in the United Kindom is, c/o Stevens, Langner, Parry & Rollinson, 5 to 9 Quality Court, Chancery Lane, London, W.C.2.

Forthcoming Events

EXETER

Oct. 28.—Institute of Chemistry (Bristol and South Western Section). "Electrometric Methods of Analysis and Investigation." Professor H. T. S. Britton. 5.30 p.m. University College, Exeter.

LEEDS

Oct. 26.—Society of Chemical Industry (Yorkshire Section). "The Deterioration of Lubricants in Use." Lieut.-Col. S. J. M. Auld. 7.15 p.m. Leeds University.

LIVERPOOL

Oct. 28.—British Association of Chemicals (Liverpool Section). Section meeting. Victoria Hotel.

Oct. 30.—Chemical Society. "Electron Diffraction and Surface Structure." Professor G. I. Finch. 6 p.m. Liverpool University.

LONDON

Oct. 26.—Chemical Club. "Science and Politics in Europe." Professor J. C. Drummond. 8.15 p.m. 2 Whitehall Court.

Oct. 27.—Institute of the Plastics Industry. Annual meeting and joint meeting with the Plastics Group of the Society of Chemical Industry. Presidential address. Sir Gilbert T. Morgan. Science Museum, South Kensington.

Oct. 28.—Institute of Fuel. "Distribution of Size in Coal as Mined, and after Treatment." Captain J. G. Bennett. 6 p.m. Geological Society Room, Burlington House, London.

Oct. 29.—Chemical Society. "Mediaeval Pigments and Mediums Used in Painting." Professor A. P. Laurie. 8 p.m. Burlington House, London.

Oct. 30.—Institute of Chemistry (London and South East Counties Section). Annual dinner-dance. 7 p.m. Strand Palace Hotel.

Oct. 30.—Institution of Chemical Engineers. Public lecture. "Research at the Lowest Temperatures and its Importance to Industry." Professor F. A. Lindemann. 6.30 p.m. Institution of Civil Engineers.

Oct. 30.—Royal Institution. Conversazione. 8.30 p.m. 21 Albemarle Street.

New Companies Registered

Carbonising and Refining, Ltd., Furnival House, 14/18 High Holborn, W.C.1.—Registered October 12. Nominal capital of £8,000. To adopt an agreement with Positive Retorts, Ltd., for the acquisition of certain patents and patent rights, to acquire, manufacture and deal with inventions and other matters relating to coal and shale distillation or carbonisation or similar processes, and to carry on the business of producers, distillers, refiners, blenders, suppliers and distributors of petroleum products, and other liquids, chemists, chemical manufacturers, etc. Directors: John Bushanan, Lt.-Colonel John C. Plowden, and Captain Chas. R. Knowles.

Books Received

Inorganic Chemistry, A Survey of Modern Developments. Sir Gilbert T. Morgan and Francis H. Burstall. Cambridge: W. Heffer and Sons, Ltd. Pp. 462. 15s.

Remington's Practice of Pharmacy. Eighth edition. By E. Fullerton Cook and Charles H. LaWall. Philadelphia and London: J. B. Lippincott Co. Pp. 2,162. 45s.

Report of the Government Chemist upon the Work of the Government Laboratory for the year ended March 31, 1936. London: H. M. Stationery Office. Pp. 46. 9d.

Essential Principles of Organic Chemistry. By Charles S. Gibson. Cambridge University Press. Pp. 548. 18s. net.